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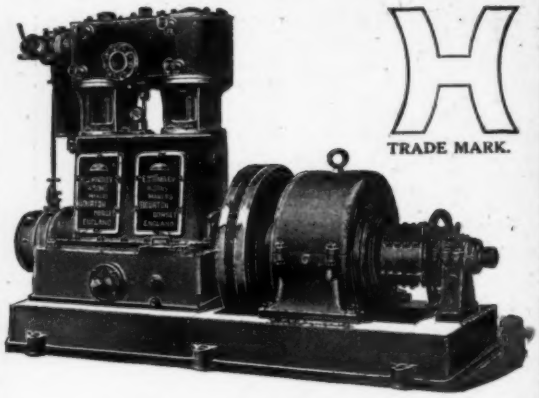

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VOL. LXXXVIII. FEBRUARY 4, 1921. No. 2,254.

ELECTRICAL REVIEW.

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GERMAN INDUSTRIES IN 1920.

A MORE favourable impression will be left on the minds of those who peruse the latest official report on the industrial and economic situation in Germany than that which was created by the report for 1919. At the same time, it would have been better if the Department of Overseas Trade had characterised the present document as a report for 1920 rather than to have set it forth as dealing with the situation in December, 1920, because the report contains very little — if, indeed, anything — appertaining to the final month of last year.

The report, which has been prepared by Mr. J. W. F. Thelwall, commercial secretary to the British Embassy, Berlin, assisted by Mr. C. J. Kavanagh, British commercial secretary in the occupied territories, Cologne, states that on looking back over the past two years it is impossible not to be struck by the evidence of improvements in all departments of public life in 1920, excepting State finance, as contrasted with the previous year. In itself this assertion merely confirms everything which it has been possible to gather from the German newspapers during the past two years. The two chief impressions formed by Mr. Thelwall in surveying the country's activity in 1920 are represented by the constitution of combines within the country and co-operation with foreign groups. These combines, which aim at uniting whole branches of industry, are said to be intended to be an alternative to State ownership. The problem, however, might have been set in stronger terms, as the combinations are also partly being promoted to defeat State ownership or socialisation. Unfortunately both of the commercial secretaries fall into the error of also applying the word "syndicates" to these financial amalgamations and communities of interests by means of an interchange of shares between the companies concerned. Syndicates are industrial associations of manufacturers for the regulation of production and prices, and the members are financially entirely independent of each other.

As the report reminds us, the inclination to form combinations has so much increased that the bulk of the coal, iron and steel industries will be held by a few groups led by dominant personalities, and while these are perhaps the most striking on account of size and power, similar organisations are in existence or in process of formation throughout the country. The old chemical trust, for instance, has been strengthened and prolonged, shipping is said to be controlled by two companies only, and the electric lamp industry, the motor-car industry, and the oil and fat trades have formed trusts of their own. Moreover, manufacturing firms have established connections with companies in other countries, either by granting the latter a direct interest in the German concerns or by the formation of a company abroad in which several German companies participate, with the object of ensuring the delivery of raw materials. Such arrangements have been made in the oil and margarine industries with the Dutch, in the electrical and textile industries, and in shipping, with the Americans, in the rubber industry with the British, and in ores with the French.

Turning to the consideration of the export trade, we find emphasis laid on the fact that the country must concentrate a large part of her energies on developing this

trade as being one of the most effective means for bringing about economic restoration. It is impossible to say how far she has been successful, owing to the absence of official figures, but the report remarks that all indications go to show that the country has lost none of her old skill in adapting herself to the requirements of various markets, and in organising and directing her export trade into the most profitable channels. No doubt the foreign trade would expand even more rapidly if it were not hampered by a complicated system of licensing, but despite this, it is said that German competition will be found and must be reckoned with from South America to Japan, there being quite enough neutral and Allied shipping to carry it there. As the goods start with the initial advantage of lower costs of production, freight rates do not deprive them of their competitive power as compared with goods made in other European countries. The subject of coal is discussed at some length, and it is concluded that while German industry is not abundantly supplied with coal, it is far from being annihilated through the lack of it, and the situation is improving in so far as the production of coal is concerned.

The position of the iron and steel industries is dealt with at some length by Mr. Kavanagh, who points out that the most prominent feature is the rapid progress which has been made in extricating the industry from the state of disorganisation which followed the losses of territory and productive works under the Treaty of Peace. After referring to the soaring of prices of iron and steel down to April, 1920, he states that it was not until the Eisenwirtschafts Bund (Federation of the Steel Industry) came into operation in that month that any sort of stability was visible in the market. Quite so, stability in prices under the dictation of the Government. The Commercial Secretary, however, does not tell us that this so-called self-governing federation was forced on the iron and steel makers against their will; that it is composed of 70 members, of whom only 17 are steel makers, 35 are workmen members, and the remainder are merchants and consumers; that the federation is in reality controlled by the workmen members and the consumers with the support of the Minister for Economic Affairs; that it is a re-introduction of the war-time system of compulsory administration for ulterior political purposes, and is hampering the development of the industry, despite the urgent demands of the steel makers for the immediate abolition of this "self-governing body."

Dealing also with the subject of amalgamations, the report remarks that smelters and steel makers are acquiring coal interests, and assimilating rolling mills, sheet metal works, and shipyards, and mechanical and electrical concerns are entering into agreements with iron and steel producers with a view to ensuring a sufficient supply of raw materials. The resulting combinations in some cases are of considerable magnitude, and one case—that of the Siemens-Rhine-Elbe-Schuckert Union—has given rise to a concentration which controls a capital of 500,000,000 marks, and employs 200,000 hands. It is also recalled that the A.E.G. has concluded a working agreement with the Burbach-Eich-Dudelingen Steel Co., Luxemburg, through the former's association with the Felten and Guilleaume Co., although this chiefly concerns the supply to the latter of semi-finished steel to compensate for the loss of the Steinfort (Luxemburg) Steel Works. In addition, particulars are given of other amalgamations, and it is added that further fusions are in prospect. The report also deals with the mechanical engineering industry, which is referred to in another part of the present issue.

The further parts of the report treat of the chemical industry, oils and fats, the textile industry, labour, and the cost of living. But apart from the passing references to electrical firms already given, and a brief note on electrical power stations, we look in vain for any particulars concerning the electrical *manufacturing* industry, while even the shipbuilding industry is dismissed in eight lines. If information respecting these two important industries becomes available to persons outside Germany, it should also be at the disposal of those residing there; and it is very unfortunate, to say the least, that prominence should be given to certain industries to the practical exclusion of others which are of importance, at least equal to, if not greater than, that of those which combine to swell the volume of the report.

Non-Statutory Suppliers.

An idea seems to be germinating that an opening may show itself, sooner or later, for some unconsidered trifles to be picked up in the way of unauthorised distribution of electricity supply. The idea is that when the various Joint Electricity Authorities get under way there will be transmission lines here and there and everywhere in a district, and that a discreet Autolycus, dispensing with any statutory permission or powers, can quietly start distribution, purchasing his supply in bulk. Being under no restrictions and unhampered by any duties or obligations, he foresees a good harvest in this form of enterprise. Up to the present, although there are a number of non-statutory electric supply companies, a natural limit has been placed on them by the fact that they have been obliged to provide generating stations and so on, with the corresponding increased risk. It was felt by the Board of Trade Electric Power Supply Committee that it was advisable to give these companies an opportunity of regularising themselves at a small cost and by an easy statutory procedure, and under the 1919 Act the Special Order which was substituted for the more ponderous Provisional Order covers such eventuality. It is up to the Electricity Commissioners therefore to check promptly an extension of irregular supply of the kind anticipated; otherwise there might crop up a swarm of these pygmy systems of distribution which would seriously stand in the way of the systematic methods ensured by the terms of a statutory Order. A statutory undertaker must distribute practically to everyone who wishes it, in the given area. A non-statutory supplier is not loaded with such public duties. Our remarks do not apply to most of the present non-statutory companies, which are indeed giving supply to the public in unimpeachable style. But the netting of the country with bulk-supply transmission lines may entice forth quite a special kind of adventurer, who should both in the interests of the public and of the industry be peremptorily discouraged.

I.E.E. Informal Meetings.

The informal meetings of the Institution are maintaining their high standard, and establishing their claim to become a permanent feature of its proceedings. On Monday last an excellent discussion took place on Mr. Milne's pet subject—the cheapening of electric wiring. This is a matter to which we have previously drawn attention as one of urgent importance, and it is somewhat to be regretted that the discussions, according to the rigid rule of these meetings, are not available for publication. This defect, however, is to be remedied, as it is proposed to furnish a précis of the discussion to the Press on future occasions.

The Liverpool Inquiry.

Great interest has attached to the proceedings at the inquiry—the first effective inquiry under the 1919 Act, for the Bristol one no sooner began than it ended for the time—which was held at Liverpool last week. The proceedings occupied five days, and were adjourned for a month or more. It is clear, therefore, that an inquiry of this nature, affecting the complete reorganisation of electricity supply in an industrial area of the first importance, and the outlay of 4 or 5 millions sterling, is a very onerous and protracted undertaking, and if later inquiries are equally exhaustive, the Commissioners will have a busy life during the next year or two.

The inquiry revealed the fact that certain authorities within the area, both municipal and company, were by no means favourably disposed towards co-operation, still less towards absorption in the scheme; the Commissioners have no compulsory powers, except the power of withholding sanction to extensions of plant, and therefore any undertaking which chooses to stand out and carry on as at present can do so. We hope, however, that no such action will be taken as will impair the efficiency and success of the Joint Electricity Authority which will doubtless be set up.

MESSRS. HIGGS BROS.' MOTOR WORKS.

We recently had the pleasure of visiting the works where the Higgs motors are made, at the Sand Pits, Birmingham, and procuring photographs of their equipment and products.

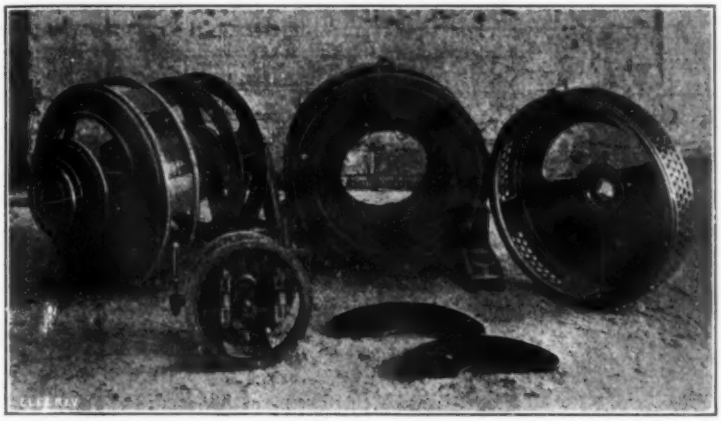


Fig. 1.—Assembled Components of an A.C. Motor.

Fig. 2.—Exterior of Works

This young firm has "made good" in a comparatively short but strenuous time, and its methods are characterised by certain features, particulars of which, we trust, will be found interesting.

In the first place, it is worthy of note that Mr. W. F. Higgs, the founder of the firm, whilst acquiring knowledge and experience as an apprentice, always kept before his mental vision a determination to establish a business of his own—a purpose which, in these days of big concerns, requires a good deal of pluck and resolution. In 1912 he commenced operations at Balsall Heath, in premises occupying 1,500 sq. ft., with a staff whose combined wages for the first few weeks amounted to £4 12s. a week; the rent was £7 10s. a quarter, electric power cost £8 a quarter, gas £3, and insurance £1 10s. a year. With this small beginning, he carried on for 12 months—and made a net profit of 100 per cent. on his modest capital! From these figures the young manufacturer may draw encouragement; clearly there is still scope for a small manufacturer, provided that he has the ability and application necessary to deserve success. In those days the largest size of motor made by the firm was rated at 5 h.p.; not only home but also German competition had to be faced, and the greatest care was necessary to secure the utmost economy of labour and material.

Since then, of course, the firm of Higgs Bros. has made great strides, and has firmly established its position in the national goodwill; but true to the original idea, it has grown up entirely on its own foundation, admitting no outside capital, and incurring no debt. Motors are now built up to 50 h.p., a limit beyond which Mr. Higgs, who controls the designs, will not go, as the factory equipment is designed for dealing with a maximum weight of one ton. While the brisk demand arisingout of the war conditions naturally helped the development of the business, the impossibility of carrying out extensions had a contrary effect, and when the business was transferred to the Sand Pits in 1917, it was necessary to make the best of such accommodation as was available; this took the shape of two five-storey buildings, cut up into some 40 shops, so that the lay-out is far from ideal. In spite of this drawback, the firm has prospered in its new home, but when, as planned, it is able to move to a more convenient building, it will be in a position to make further economies in the processes of manufacture.

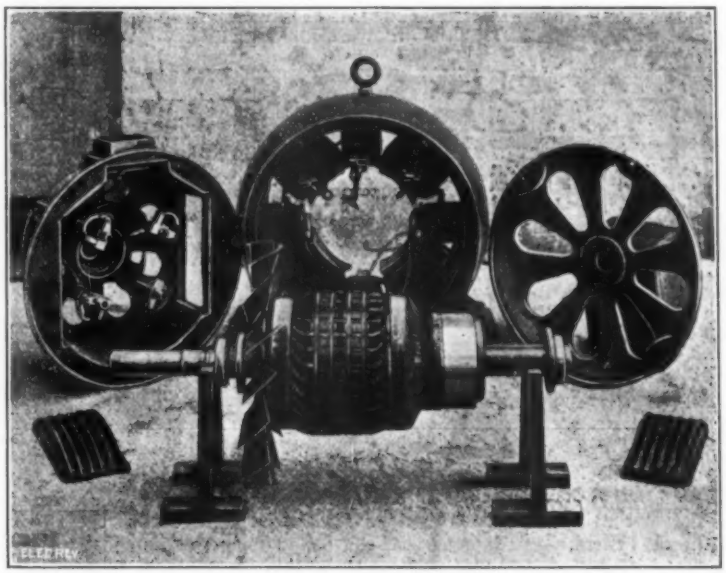


Fig. 3.—Assembled Components of a D.C. Motor.

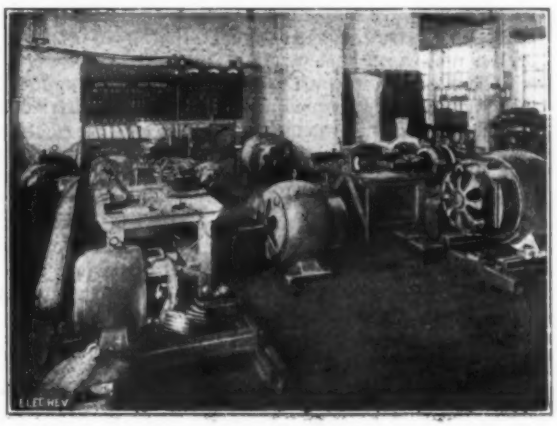


Fig. 4.—Experimental Shop.

As illustrating the progressive policy of the firm, we record with much pleasure the fact that in 1917 the metric system was substituted for English weights and measures throughout. In the ordinary course, new designs were in preparation, and these were drawn out entirely in metric measures, with the exception of the steel for shafts, which could not be obtained in millimetre sizes. Mr. Higgs

Fig. 5.—Special Machine Shop.

if a special machine is asked for, a standard machine is offered that will do the work with reliability. All the motors are fitted with ball bearings, which enable small clearances to be safely employed, resulting in high efficiency and high power factor.

Messrs. Higgs Bros. have never had any trouble with their workmen, even when strikes have been in progress elsewhere; their policy is to pay good wages, treat the men well, and to take a real interest in their welfare. Amongst the amenities which they have provided are a works canteen, football field, and rifle range, and the sports club is a popular institution. The authority of the foremen is safeguarded by passing all communications with the men through their hands, but, at the same time, direct contact with the men is maintained, the foreman being a party to all interviews.

Piecework is in force throughout the works, but is not favoured by the firm; when conditions permit of it, the "conveyer" system will be adopted, with high, but fixed, wages. An efficient organisation to keep every man supplied with work is considered essential to economical production, and punctuality in the highest offices is obligatory, for the sake of example.

The great majority of the machines sold are supplied direct from stock, there being usually from 400 to 500 finished motors in stock, and 1,000 in course of manufacture. An elaborate system of stock-cards is in use, which ensures

Fig. 6.—Heavy Machine Shop.

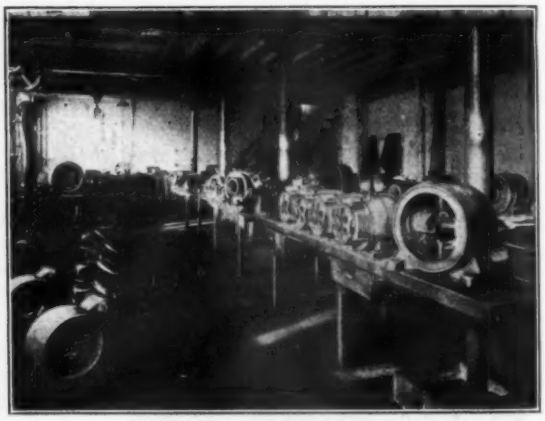


Fig. 7.—Assembly Shop.

derides the statement which is constantly made by opponents of the system, that the cost of the change is ruinous; as we showed in a series of articles in 1915, this objection is imaginary. The decimal metric system is now in use throughout the factory, except for screws larger than the B.A. sizes (which are already metric), and Messrs. Higgs Bros. would prefer to use the metric screws if they were obtainable, regarding the design of the thread as superior to the Whitworth type.

The motors built by the firm are rigidly guaranteed to comply in every respect with the British Engineering Standards, and with the makers' specification; if a customer is not satisfied with a machine, it is either made satisfactory or replaced by another. On January 1st, 1921, we were informed, prices were reduced not only on new orders, but also to an equal amount on those in course of execution.

The firm objects to a maximum temperature exceeding 200° F. in any part of a machine, and while it recognises the necessity of rating a machine up to the maximum safe load, it regards reliability as the supreme consideration, to which all others must give way. For this reason, the first machine of a new design is built with thermo-electric temperature indicators incorporated in its structure; by this means precise information as to its proper rating is obtained, and it is certain that repetitions of the same design will give the same results.

The motors are built for d.c. and two or three-phase a.c., in two types—"protected," and "enclosed ventilated"—and are suitable for most applications in mills, factories, &c. No variation from the standard designs is permitted;

Fig. 8.—Winding Shop.

that, say, six machines of a certain size are always in stock; when that limit is reached, a batch of six more is put on order. A system of keeping monthly records in the form of curve diagrams is also employed, giving minutely detailed information on a wide range of subjects, such as manufacturing costs, wages, insulation failures, &c.—the set of curves numbering upwards of 30, and being always kept up to date.

The method adopted for controlling designs is of interest.

The structural details of a particular design are fixed, after due investigation and experiment, by Mr. W. F. Higgs, but the windings have to be varied to suit "the infinite variety" of voltages and frequencies enjoyed by the long-suffering consumers in this country. A folder is set apart for one standard mechanical design, the whole of the details of which are invariable; this folder contains a series of design sheets recording the data corresponding with the different windings used with that particular carcase.

Fig. 9.—Test Room.

The drawings are prepared in accordance with a uniform system which has been developed to a high degree of perfection, each detail having a standard sheet to itself, showing only those dimensions with which the shop is concerned; moreover, on corresponding drawings of the same detail, but of different sizes, the lettering, and even the positions of the lettering and dimension lines, &c., are identical, except in respect of the dimension figures themselves. Every item without exception that is required for a machine is entered on the list of material for that machine, and no machine is allowed to go into stock until it is complete to the last screw.

The stock is divided into three classes:—(1) single component parts; (2) assemblies of components; and (3) complete machines. In every case orders are put through in batches, the number of items included depending upon the size and nature of the particular part, but never being less than six. Taking, for example, a batch of six steel shafts; the batch is started on its course, accompanied by a card containing particulars regarding the order, the number of operations and the time allowed for each operation, and other necessary data; provision is made for recording the inspection of the part at appropriate stages, and the batch is not accepted in the stores unless every item is present and completed. Even spoiled work has to remain with the order up to the final inspection and arrival at the stores, so that no scrap accumulates in the shops, and no part is ever lost. Cast-iron yokes, which are at present purchased in batches of 20 to 50, are received into the "rough castings store," which is a buffer between the delivery office and the workshop, and each batch is controlled by a stock card, so that the precise quantity available is always on record.

Figs. 1 and 3 show the chief assembled components of standard a.c. and d.c. motors. The d.c. machine has a cast-iron yoke with mild steel poles and interpoles cast in place: all machines above ½ h.p. are provided with interpoles, and every machine is capable of a speed variation of 100 per cent. by field control. The ball bearings are of the same size at both ends of the shaft, and the machines are reversible without moving the brushes, commutation being on the neutral point. There are no loose wire connections inside the machine, stiff wires being used, with soldered joints. The poles are provided with laminated shoes, and the coils are wound with enamelled wire, taped with black tape, and labelled with a stamped metal number disk which enables a user to be supplied with an exact duplicate in case of need. The motor is thoroughly ventilated by a fan attached to the armature. The terminals are housed in a compartment in the top of the yoke, which is covered with a c.i. box containing spare brushes and springs, running instructions, a lubricator, and enough grease to last for two years—the use of the right kind of grease being essential to the success of ball bearings. The d.c. machine is dispatched from the works bolted to a couple of battens, without a crate, a method which has proved both satisfactory and economical (for this reason the lubricator above-mentioned is put into the box for safety in transit).

The brush gear is of particular interest; the arms are fixed to the rocker by an ingenious coned joint, which ensures permanent rigidity, and the brush-holder box is a die-stamping of metal having a tensile strength of 33 tons per sq. in. and an elongation of 15 per cent. Morganite Link 1 brushes are used.

In the a.c. motor the outside of the stator laminations is exposed to the air; the stator is wound with formed coils, of wire enamelled and single-cotton-covered in the small sizes, d.c.c. in the larger. The enamel coating stands a pressure of 2,800 V between adjacent layers. The interior of the stator, and the exterior of the rotor, are ground, so that a very fine clearance is practicable, the size of which is known with certainty to 10 per cent.

The rotors are always wound three-phase, and provided with two radial slip-rings, the shaft providing the third contact. A simple but effective short-circuiting gear is used. Squirrel-cage rotors are built on the system described in our issue of May 14th, 1920, with flat copper bars, twisted at the ends so as to form a cylinder, and welded together, making a sound but inexpensive job.

We give herewith a number of views taken in the workshops. The firm is self-contained as far as possible, and intends eventually to have its own foundry. Core laminations are stamped on the premises, and coated with insulating paint by spraying. Die stampings are used for couplings, brush boxes, &c. All shafts are ground to a finish, and the machined parts are made completely interchangeable with the aid of gauges. The bases of castings are faced in the lathe, not planed. All jigs, tools, and gauges are made on the premises. Several single-purpose machine tools, designed and built by the firm, are installed. Pulleys are made on novel lines, the face being finished in one cut. The variety of parts stocked is kept down to the minimum; for example, 17 different screws suffice for the whole range of 32 standard machines, from ¼ to 50 h.p.

Every machine is tested on load for three hours, flashed five times, and certified by the head of the testing department, which is equipped with means for carrying out tests at any frequency from 25 to 60 cycles, and any pressure up to 3,000 V.

Fig. 10.—Finished Motor Store.

In concluding this brief sketch of the firm's activities, we desire to express our appreciation of the cordial reception accorded us by Mr. W. F. Higgs, A.M.I.E.E., and his partner, Capt. C. Higgs, M.C., R.E., on the occasion of our visit. Messrs. Higgs Brothers cast their name on every machine that they build, with pardonable pride—for it is the mark of a machine which can be depended upon to do all that is claimed for it.

EDISWAN JUNCTION BOXES.

Amongst the various difficulties with which electricity supply engineers have had to contend during the last few years has been the slow production of junction boxes. Bad as the position was for obtaining deliveries during the war, the supply undertaking could feel that it had other reasons as well, backed by the approval of the Government and public, for the exercise of deliberation and selection in extensions of networks and the connecting-up of new consumers. Since the Armistice, hundreds of new consumers have been clamouring for connection, but the supply of straight-through and terminal boxes for the new mains, and service boxes and house-service cut-outs for new consumers, lagged months behind the demand. Arrears accumulated during the moulders' strike, and now, although foundries are gradually making up for lost time, cable deliveries are also appreciably better, and the demand for junction boxes is likely to show little sign of abatement.

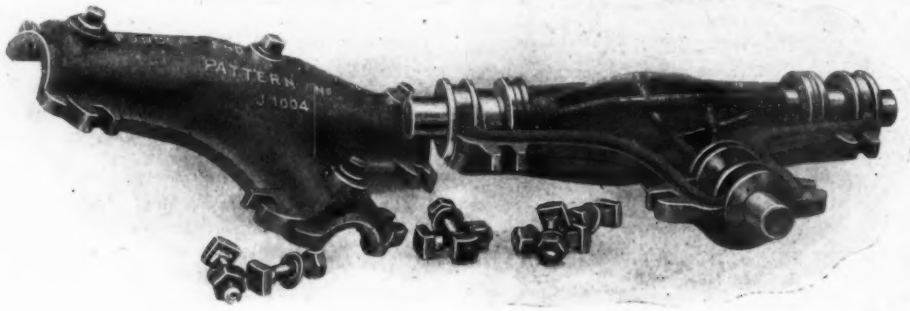


Fig. 1.—House-service Box for 3-core Cable.

In these circumstances, it is not surprising that the Edison Swan Electric Co., Ltd., whose cable department has developed as rapidly in the output of main cables as in the supply of cables for house wiring, should have decided to commence the manufacture of junction boxes at the Ponders End Works.

The Ediswan boxes, while following the lines which have been found most suitable for normal conditions in general practice, possess some interesting features in technical detail. Fig. 1 illustrates the three-core service box, a feature of which is that, while there is ample room for making connections, and good clearance between the conductors themselves and the wall of the box, the amount of compound required for filling is reduced to a minimum. This point will be particularly appreciated by engineers in charge of large networks, on which the expenditure on box compound is a serious item. It will be seen by the illustrations that the compound gland type has been adopted, and that the uncertainty of proper bonding between the lead of the cable and the box, occurring in some designs, is eliminated by a tinned copper earthing strip at each way, which is sweated to the cable and screwed down against a machined surface on the box itself. Another point, which will meet with the approval of the practical mains engineer, is the thickness of the lugs. Many engineers know to their cost the trouble from breakages of lugs in the earlier designs of junction boxes.

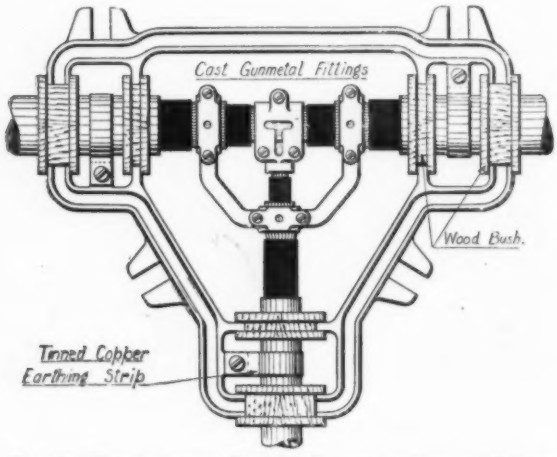


Fig. 2.—House-service Box for Triple-concentric (Middle and Neutral) or Concentric Cable.

Fig. 2 shows the design of one of the service boxes for use on triple concentric distributors—the one for taking a service from the middle concentric conductor and the neutral without exposing the middle conductor—and it will be found a convenience that the castings of these boxes are made to be interchangeable with those for use on ordinary two-conductor concentric cables. The boxes for services from the inner and neutral conductors of a triple concentric cable are larger, as the middle concentric conductor has to be cut in order to bare the inner one, and sufficient length has to be provided for the fitting to re-connect it.

In its terminal boxes the Ediswan Co. has adopted the wiping gland in preference to the compound gland. The former, although it may involve the exercise of a little more skill in fitting-up the box, always presents a neater appearance, ensures good bonding, and eliminates the drippiness and stickiness which is frequently in evidence when a compound gland is used in a vertical position. The company has departed from the usual practice of screwing the wiping gland into a thread cut in the two halves of the box. With a screwed-in wiping gland, it is virtually impossible to have a perfect joint both between the two halves of the box from top to bottom and between the gland and the box. If one is sufficiently tight, the other is apt to be too loose. In the Ediswan pattern, the brass wiping gland has a wide flange which is bolted to a machined surface on the lower end of the box. The bonding is thus perfect, and at the same time the two halves of the box can be bolted tightly together and the compound poured in at a high temperature without any risk of its leaking. Separate bushes are provided for each of the tails, which have a straight vertical run, making short-circuiting absolutely impossible.

Fig. 3.—D.P. House-service Cut-out with Sealing Chamber (Open).

The Ediswan Company has issued an illustrated list of its low-pressure boxes, in which these and other patterns are described in detail. A feature of this catalogue is a list of a

dozen sizes of plain cast-iron cases with iron covers with a list of extras for tapped bosses for conduits, wiping glands, sealing glands, packing glands, and filling plugs to make them adaptable to any purpose for which special boxes are required.

Together with the above list, a separate catalogue of house-service cut-outs has been brought out. This includes a neat pattern of combined double-pole cut-out and sealing chamber which should entirely remove the prejudice against placing the fuses of both poles in one case. As is seen by the illustration (fig. 3), the cover opens downwards. The fuses are of the well-known Ediswan Home Office pattern, separated by an insulating fillet, and accidental short-circuiting or earthing is virtually impossible. The cable can be led in either at the

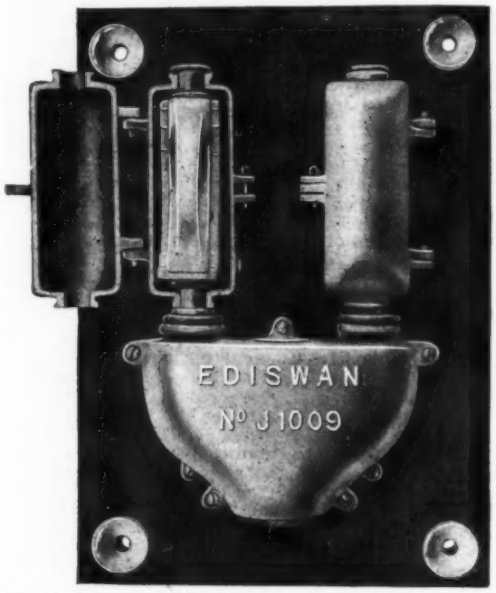


Fig. 4.—Service Fuse Board with s.p. Fuses and Sealing Chamber.

bottom or either side, as three blank bushes are provided. A similar design is adopted for the triple-pole cut-out, two patterns being made, one with three fuses for 3-phase services and the other with a link instead of a fuse in the middle for 3-wire d.c. services.

For those who still prefer to employ single-pole fuses, a well-fitting and substantial sealing chamber (shown in fig. 4) has been brought out. In this there is a separate bush for each pole, and attention has been paid to a proper fit between the two halves. Ironclad house service switches, single-pole Home Office pattern cut-outs, and house service panel boards are also included in this list.

CHEMICAL AND METALLURGICAL ASPECTS OF ELECTRIC ARC WELDING.

By J. H. PATERSON, D.Sc., F.I.C.

(*Abstract of paper read before the* Institution of Electrical Engineers, Liverpool Sub-Centre *of the* North-Western Centre.)

In this paper the author gives some account of the probable chemical composition of the metal which is filled into a weld made by the iron process, and of the variations in micro-structure which are produced. The carbon content of the metal can be neglected, as it is usually very low, and is not a dominant factor.

As a weld is made in an atmosphere rich in oxygen, the deposited metal should contain oxides of iron, but analysis shows that in addition considerable quantities of iron nitrides are also produced. The quantities of oxygen and nitrogen to be found in a weld metal may be gauged from the following curves (fig. 1).

The decrease in the quantity of oxygen with the increase in the current strength is noteworthy, and is probably brought about by the greater fluidity of the metal deposited at high current strengths owing to the general temperature of the weld being higher. This gives the globules of oxide present time to coalesce and come to the surface of the weld where they form a slag.

Whether any of the oxide present in the weld goes into solution in the iron or not is a debatable point. The microscopic examination of any weld shows the presence of quantities of small threads and globules of slag (probably iron oxides of various kinds), but whether the iron itself dissolves any iron oxides while fluid is not very clear. The necessity for knowing something definite on this point is due to the fact that if the molten iron dissolves iron oxide while fluid and then allows of its complete or partial separation during cooling, serious disturbance of the mechanical properties of the iron may be expected. If, on the other hand, the oxide does not dissolve, then the iron oxide present will be very like the slag present in wrought iron or cast steel, it will only act as a diluent to the good metal surrounding it.

Dr. Rosenheim is of the opinion that ferrous oxide is insoluble in iron, and points out the notable constancy of the melting point of pure iron by various investigators as strongly supporting this idea. Messrs. Rawdon, Groesbeck, and Jordan, in a recently published paper, give an account of work done by them in the laboratories of the U.S.A. Bureau of Standards on weld metal, in the course of which they found that, on heating a piece of weld metal in vacuo for six hours at 1,000 deg. C., the globules of iron oxide coalesced into larger particles. If it is assumed that the globules are iron oxide then the migration of the particles can only be assumed to have been caused by the solution and subsequent redeposition of the iron oxide in the surrounding iron. Other investigators have failed to find any movement of iron oxide inclusions in cases where the inclusions were known to be iron oxide only. Numerous experiments, most of them not very convincing, have been done to show the effect of nitrogen on the mechanical strength of steel, and as a result, quite a number of metallurgists are agreed that more than .01 or .02 per cent. of nitrogen in steel is dangerous. As weld metal contains normally from eight to ten times these quantities it may be assumed that, if their theories hold good, the metal produced in electric welding owes all its weaknesses to the nitrogen content.

The presence of all this nitrogen is a matter of considerable interest as iron in the molten condition is barely affected by it. Andrew, by heating iron for long periods in an atmosphere of nitrogen at high temperatures, succeeded in producing alloys of iron and nitrogen containing 0.3 per cent. of the latter element. As weld metal is only hot for a few moments, this cannot explain the production of 0.15 to 0.16 per cent. of nitrogen in weld metal.

In 1911, R. J. Strutt showed that under the influence of a high-pressure discharge nitrogen became chemically active, and would rapidly combine with metals such as sodium, magnesium, and calcium at ordinary temperatures. Later Koenig and Elod showed that active nitrogen was produced when the gas was drawn through a d.c. carbon arc, and it would appear probable that the high proportions of nitrides present in weld metal are due to the existence of this very active form of nitrogen in welds produced by the carbon-arc process, and also in steel melted in the electric furnace, which shows that

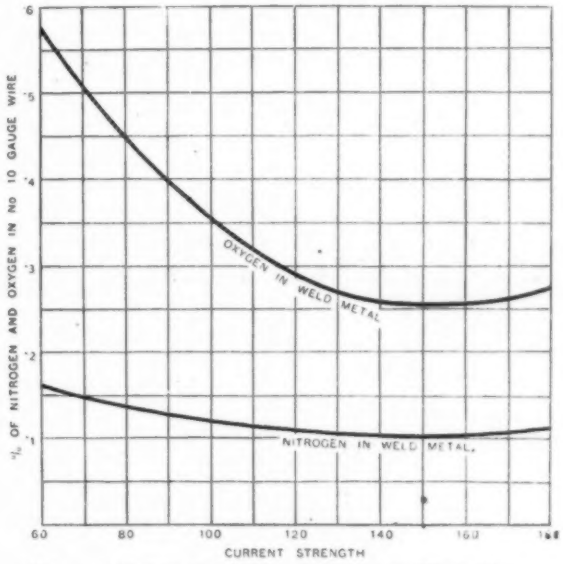


Fig. 1.—Oxygen and Nitrogen Found in Weld Metal.

either the carbon monoxide produced in the arc exercises some protective influence on the weld, or that some other not fully understood phenomena are produced.

The methods for the determination of nitrogen in metal are faulty, because one cannot be sure that in any given specimen the determined nitrogen is all the nitrogen the metal really contains. The author has pointed out that when weld metal is heated in hydrogen a certain amount of the nitrogen is given off as ammonia, a certain amount is given off as apparently uncombined nitrogen, and a certain proportion remains in the metal. In one case, for instance, a weld metal containing 0.095 per cent. of ntirogen when heated for thirty minutes in a current of hydrogen, gave off 30.5 per cent. of the element as ammonia, and the residue on analysis still

contained 23.1 per cent., showing that 46.4 per cent. had escaped as uncombined nitrogen.

Rawdon and his collaborators found that specimens heated in vacuo lose nitrogen to the extent of about 50 per cent. As, however, their metallographic researches do not coincide with this loss, they suggest that the ordinary methods of analysis only determine the nitride nitrogen, and that the quantity apparently eliminated on heating has really been converted into another form which is unattacked by the reagents used. This is a very improbable explanation, especially in the light of the author's results, but the fact remains that a large field for interesting and informative research opens up in connection with the presence of both oxygen and nitrogen in steel. It is hoped by making specimens of weld metal in which nitrogen cannot possibly exist, by making welds in nitrogen perfectly free from oxygen, and by the study of these welds, that definite conclusions will be arrived at.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

A Generator Problem.

I have followed "Wireman's" trouble for the past few weeks. I should like to try and help him, as I had the same trouble last June. I tried reversing the shunt, then the armature; then I tried exciting one of the shunt coils off a 500-volt circuit with a set of lamps in circuit with the one shunt coil, and coupled up the other three coils across the armature, and it would generate quite all right. The only method that worked satisfactorily and overcame the trouble was to couple a wire through a switch so as to short-circuit two of the shunt coils, leaving only two of the four coils across the armature until the voltage rose, say, to 200 volts; then to switch off the short-circuit and leave the four coils in series.

Wm. John.

Crynant.
January 26th, 1921.

It is evident from the particulars given in your issue of December 17th, 1920, that the machine in question is intended for separate excitation, as, if 480 V were applied to coils wound for 60 V, they would promptly burn out.

I would suggest that "Wireman" should test the field current passed by the motor and compare this with that passed by the generator with all field resistance cut out. He will in all probability find that it is exactly, or approximately, the same. If such is the case, it clearly proves my contention *re* separate excitation.

With reference to the series winding, if this is on the main poles it should be connected in opposition to the main excitation, the reason being that this has the effect of reducing the amount of current flowing during the striking of the arc, and also contributes greatly to economy in current by reducing to a great extent the amount of series resistance needed in the arc circuit.

I should further like to point out that the reason for adopting separate excitation is that if the machine be self-exciting, it is possible for the series coils to overcome the shunt coils and destroy the excitation of the machine, if the arc is not struck quickly, and with plenty of series resistance in circuit.

I have been able on several occasions, by careful regulation of the excitation, to obtain a balance between the series and shunt coils and maintain a steady arc without the aid of any series resistance in the arc circuit.

Frank S. Rumball.

Luton, *January 29th*, 1921.

Shop Displays.

In common with many of your readers, I have read the correspondence under the above heading with interest, mingled with mixed impressions of disappointment and hope.

I dislike unidentified letters, which savour of lack of courage, and also deplore the vituperative tone of Mr. Tate's replies. It is also unfortunate that Mr. Cohen should endeavour to redress his grievances through the hospitality of your columns, seeing that more constitutional methods were available. We all have cause for complaint, and Mr. Cohen should memorise the lines of Seneca which read: "Let no man presume to give advice to others that has not first given good counsel to himself."

As a member of the E.C.A. I have for many years been known as "the Opposition," and also by the much respected Mr. Cash as the "Gadfly." Why? Because I endeavour to stimulate those silent and sluggish members who are content to let others overburden themselves with duties whilst they—the silent ones—refuse to give support by attending meetings, being content to pose as injured and ignored.

To "Retailer" and others I beg to give a few lines of advice: Primarily, they are certainly unaware of the difficulties confronting them in their endeavour to found an organisation which will create their *ideals*. Secondly, they are neglecting the excellent prospect of success and are retaining the sand but washing away the gold. I will be more explicit.

Let from 40 to 50 disappointed contractors, &c., who are legitimately entitled to membership, immediately join the E.C.A. Following this they must resolve to attend the forthcoming annual meetings. If they will do so they will have the opportunity of electing whomsoever they desire to represent their interests. They can remove from office those who are supposed to run the Association in their own interests, and in consequence will hold the reins and thereby be able to demonstrate their capability to create a strong representative and co-ordinate body. I hope they anticipate the magnitude of their responsibilities when they get the powers. Personal acquaintance is very educational at times.

In conclusion, your correspondence does not indicate the geographical source of complaint. Therefore I wish to indicate that although London seems so badly served, the numerous branches throughout the kingdom are seemingly happy and well catered for.

W. Ellerd-Styles.

London, N. 1.
January 31st, 1921.

The Life of Metallic-filament Lamps.

Several times recently I have been called upon to quote a price per annum for the maintenance of electric light installations, and, naturally, I have been very interested in the correspondence in your columns on the above subject.

Referring to the letter from "J. W. H." in your issue of the 28th inst., in which he says: "Generally speaking, the average life is about 200 hours for ordinary metal lamps, and 100 hours for half-watt types," I should be glad to know how "J. W. H." arrived at these figures, which, of course, must only be approximate, and to my mind are quite true with the lamps of the present-day standard of manufacture.

Take, for example, an installation of 100 ordinary metal-filament lamps and one of 100 "half-watt" lamps, in each case working on, say, 200 volts constant pressure, and assuming that the lamps are not subjected in any way to mechanical stress or shock, could "J. W. H." suggest a figure for average life in each of the cases just given as examples? I should be very interested to hear his opinion.

Referring to the so-called "half-watt" lamps, which I am glad to say are now beginning to be called gasfilled lamps by many, I have found when dealing with installations operating on a voltage of 200, that to install, in place of 200-volt lamps, lamps rated at 210 volts gives a considerably longer life to the lamps, and also the loss of candle power is not appreciable.

Maintenance.

January 29th, 1921.

I have followed with interest recent correspondence appearing in the Electrical Review on the above subject.

To my mind, the solution is not to reduce costs to take account of replacements, for that, surely, would tend to lower rather than raise the quality of lamps at the present time.

It is common knowledge that we have standard prices for metallic-filament lamps, and it is also the feeling of consumers that prices are on the high side. Therefore, as Mr. Aish suggests, if high prices are to remain, insistence should be placed upon an equally high standard of quality, thus prolonging the life of a lamp.

Many things enter into the life of a drawn-wire lamp, and one of the most important factors is the quality of the tungsten wire used in its manufacture. The quality of tungsten wire depends to a large extent on the way in which it is drawn, and, as a supplier of diamond dies, I know that a very great deal depends on the quality of the diamond die used. A really good diamond (not bort) die is comparatively expensive, but its apparent high cost is more than compensated by the long life and efficient service of the product. This statement applies not only to the drawing of tungsten wire for the manufacture of incandescent lamps, but also to the drawing of copper wire which enters so much into the electrical industry.

Filières.

January 24th, 1921.

The National Joint Board's Procedure.

I am desired by the employers' side of the No. 6 District Joint Board to send you the following resolution which was unanimously passed by them at their first meeting and subsequently confirmed by a full meeting of the Board held November 22nd, 1920:—

"That a recommendation be sent to the National Joint Board requesting that all future questions of conditions of employment or remuneration and other vital matters be referred to the various District Joint Boards for their consideration before definite decisions are reached."

As will be seen this resolution lays bare the root origin of the sore which ultimately festered and culminated in the em-

ployers finding themselves menaced with a situation which, to put it mildly, would not admit of temporising.

Had the above resolution been incorporated in the constitution of the National Joint Board, such an impasse would have been avoided and a considerable amount of "mud-slinging" saved. This resolution was submitted to the chairman of the Conference of Employers on January 7th, but he refused to accept it, as it had not appeared on the agenda, and he suggested that it should be brought to the notice of the re-formed Board. As is probably well known, the possibility of a new National Board being created has not matured, and is not likely to mature, and it is still within the bounds of possibility that the employers will have "slung" at them demands quite as exorbitant if not more so than the recent recommendations which have caused such an outburst of feeling during the last few months.

I respectfully submit that all schedules of salaries and working conditions should be considered by the District Boards before the final mandate is issued by the National Board (as is done in the case of the Industrial Councils). If this were the procedure, the District Boards would then be in a position to recommend to the undertakings covered by their areas the acceptance of the eventual findings of the national body. At the moment those District Boards which are set up have to press for adoption recommendations, which conscientiously they are ashamed to put forward and only do so in order to justify their existence. The No. 6 District Board would be glad to have the views of other Boards, and perhaps a united front may with tactful handling secure the adoption by the National Joint Board of the above or a stronger resolution in its constitution.

(Alderman) A. A. Senington,
Chairman of No. 6 (West of England) District Board.

Bristol.
January 31st, 1921.

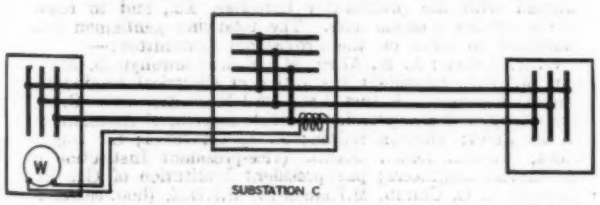
Indicating Wattmeter in Remote Position.

We notice a letter from "Inquirer" under the above title in your current issue.

As we understand the problem, it is required to indicate at the point A the power taken by stations A and C. This can readily be done by means of a current transformer (CT) installed on the incoming cable at sub-station C and connected by pilot leads with the indicating wattmeter (W) at station A, as shown in the accompanying figure.

In order to make it possible to use pilot leads of small section, the secondary current of the current transformer should be a fraction of an ampere in place of the usual 5 amperes.

It is unnecessary to run potential leads between the stations, since the line voltage at A can be utilised to excite the potential windings of the wattmeter. The potential connections have been omitted from the figure, for the sake of clearness.



We have assumed that the load can be regarded as balanced. If this is not the case, two current transformers should be installed and three pilot leads will be necessary.

If your correspondent cares to communicate with us, we would go into the scheme in detail, which is not possible without trespassing unduly upon your valuable space.

Everett, Edgcumbe & Co., Ltd.

Hendon.
January 31st, 1921.

Charging Batteries for Motor Cars.

With regard to the letter from Messrs. Rootes, Ltd., under the heading "Charging Batteries for Motor Cars," in your issue of the 28th inst., I understand Messrs. The Igranic Electric Co., of Bedford, manufacture the apparatus sought by Messrs. Rootes, their leaflet No. 780 of December, 1918, dealing with this equipment.

Marshall Tate.

London.
January 31st, 1921.

Electricity Supply from Surplus Sources.

Re your note on my letter under the above heading in your issue of the 14th inst., I realise that there are vested interests to be considered and difficulties to be overcome, but it should not be impossible to achieve at least something on the lines I have suggested. As a matter of fact, it is not infrequently done. The public supply corporations, when they get into a tight place, are glad to avail themselves of any surplus energy which a large works in the district may have available, as in this district at the present time. Also, it is done in the United States. In a recent issue of an American technical journal, in an article on "Power for Industrial Plants," it was stated that works having large demands for low-pressure steam were "producing more power than needed for their own uses, and selling the excess to power or other companies." Elsewhere in the same article it is stated that: "In some particular kinds of business, like a woollen mill, dye house, bleachery, soap factory, sugar refinery, &c., energy can be produced at rates at which it is practically impossible for the central power plant to compete."

But in the States they are accustomed to do things that we consider impossible. For instance, they supply steam or hot water tor heating from the central supply stations, thereby saving at least some of the really ghastly waste involved in discarding 60 per cent. of the heat of the fuel with the cooling water. I cannot think that any system involving such a waste can be the last word in power generation. When things are wrong, as a rule it is the system and not the individual which is at fault. If a system could be arranged which would foster these small supplies of energy (large in the aggregate) by making it worth while for the individual to study them, things would alter. I know of a large works requiring a good deal of power, so much that the canal arm becomes unduly heated by the heat discarded with the cooling water, thereby impairing the vacuum and increasing the coal consumption. On the other side of the canal there is a jam factory. How much better it would be if, instead of using the exhaust steam to boil the water in the canal, it were used, or part of it, for boiling the jam.

Again, in the same power house, there is 500 kW of plant standing idle, whilst elsewhere in the same town other works cannot be supplied because the plant at the Corporation electricity works is overloaded, and the Government will not sanction further outlay. It has been suggested that the various works in the town should provide the money for the extensions, but it would be better if by adopting some such system as I have suggested, the works were to supply the power, or part of it.

It may be objected that it could not be done at the price, but if it is being done in the case of some works, why not in others? It must be borne in mind that it is only the surplus power that is in question, and it would cost very little more than the fuel, and perhaps an extra stoker or two, to run the stand-by plant, and so the extra electricity could be developed at a very cheap rate. By linking up a number of works, as they would be if allowed to feed into the mains, it would not matter if the supply from one or two of the works were cut off, as the average would be maintained. Moreover, most of the works would be working the usual hours, so that the extra supply from the works would come on and go off just when it was most convenient for it to do so. I cannot help thinking that there is a greater possibility of obtaining cheap power by co-ordinating existing sources than by studying water power in England, and that it would be better worth while for a Government Commission to look into.

Albert Charles Pain, M.I.Mech.E.

Birmingham.
January 24th, 1921.

German Competition in the Electrical Trades.

In this matter surely the essential thing is whether Germany is better qualified for manufacturing than Britain. On this point the most essential factor is coal production, and in this Britain is better off than Germany; in fact, the largest single item of our exports to Germany was coal in pre-war days.

This country produced six tons per head per annum; Germany only three tons per head. Yet in 1913 Germany sent us £56,000,000 of manufactures and we sent only £27,000,000 to them.

In pre-war days we exported enough coal to create employment for 5,000,000 persons, that is, about 75,000,000 tons. The 10,000,000 persons employed at home requiring about 150,000,000 tons of coal to keep them employed. Germany exported very little coal—her coal exports were in the form of coal dust and clay.

Is it not remarkable that Free Trade Britain exported twice as much coal as *all* other countries together? Was it not a case of selling our *birthright*? Surely Esau ought to be our *patron saint*!

Our imports of manufactures were paid for by exports of coal, and we learn now that our foreign trade depends upon coal exports. In bulk, 84 per cent. of our exports were coal! Yet Germany exported more goods than we to protected rivals without sending them much coal!

On other points our policy seemed to be radically wrong. The three factors in wealth production are capital, labour and raw material. We exported all three in vast quantities.

In 1913 and previous years, Britishers invested less than £50,000,000 in home companies, but four times as much abroad. The rate of emigration was 250,000 a year for ten years. Yet the country could spare 80,000,000 tons of coal—a raw material that should attract all other kinds of raw material to itself!

Imports of food should be paid for by exports of manufactures, and were paid for so far as regards Empire trade.

How different our trade with our four rivals—America, Germany, France and Belgium. In 1913 we purchased £208,000,000 of food and manufactures from them, and they only bought £84,000,000 in return for these goods.

These facts prove that Free Trade was a disastrous mistake, because it hindered production by driving capital abroad.

E. Wright.

London.
January 24th, 1921.

Cost Sheets.

With reference to Mr. J. H. Whyman's letter in your last issue *re* my article on "Costing," I quite agree with him that costing to be of practical use must give as much detail as possible.

The generation cost sheet, fig. 5, did not show great detail (only the B.o.T. headings), but it will be seen by reference to the time card, fig. 2, that 12 headings appear under the item "Engines and Boilers," and this can be applied to stores sheets and all other items, also to the cost sheets.

A great deal depends on the size of the station, &c., as to the lay-out of a costing system, and I trust Mr. Whyman will see that owing to a desire to save space my article dealt more with minimum requirements than maximum.

A. Clegg.

Dewsbury.
January 31st, 1921.

LEGAL.

Norton *v.* Electrolite, Ltd.

(Traveller's Notice.)

In the Mayor's and City of London Court, on January 25th, an action was brought by Mr. H. F. Norton, commercial traveller, against Electrolite, Ltd., of Gresham Street, E.C., to recover £50 as damages for breach of contract of employment. Defendants raised a counter-claim for £89, and admitted owing plaintiff £34 subject to the counter-claim.

Plaintiff's case was that the defendant company engaged him after being a salesman in their service, to become a commercial traveller, and travel various districts for them in Oxford, Kent, Portsmouth, Birmingham, &c. He was to get orders for electric lamps, gas mantles, globes, chimneys, and everything needed in the lighting world. He began to work for them in July, 1916, at a salary of 30s. a week, and he was to have 2½ per cent. commission on the first £50 worth of orders taken weekly and 5 per cent. on the balance. He received his salary weekly as well as the commission, but the commission was afterwards paid monthly. In July last he resigned by giving a week's notice to leave on July 30th, which he did. He was paid his week's salary, and now claimed commission due to him when he left. Plaintiff maintained that he was a weekly servant and had not to give longer notice.

Defendants said that the plaintiff should have given them three months' notice or a season's notice, as they had to engage another traveller to finish his rounds which were incomplete when he left. It took the plaintiff three months to go to his various districts, and defendants had been damaged by having to engage someone else.

Frank Durants, defendants' managing director, said he thought before a traveller left he ought to take round his successor and introduce him to the customers. Defendants claimed 25 per cent. profit lost on the business which the plaintiff would have done if he had given a reasonable notice instead of a week. The terms were not very plain perhaps. Their other travellers were under contracts subject to other terms to give them one week's notice, but then they lost their commission. He did not expect travellers when they left to canvass their competitors in business as plaintiff had done. He was annoyed when the plaintiff left him and gave him a week's notice. It was just at the beginning of a season, which was the whole of the trouble. No doubt he ought to have provided for three months' notice to be given to him when a traveller left, and that was what he would have done if he had been wise. Plaintiff's practice was to call on their customers once in three months. If a traveller left in anger he would not then, of course, expect him to go round with his successor.

Judge Jackson said he thought the plaintiff should have given a month's notice, and that that would have been reasonable. Therefore, while he found for the plaintiff on the claim for commission for £34, or such sum as might be found due, he found for the defendants for £37 16s. for damages on the counter-claim.

Breach of Lighting Agreement.

On January 29th, at the Dublin Southern Police Court, the Pembroke Urban Council sued William J. Barry for a breach of a lighting contract. The terms of the agreement were that a fixed rate would be charged for a number of lights of a certain power. Defendant substituted lights of a higher wattage, and the Council therefore cut off the supply and informed Barry that he would not receive a further supply until he remitted the sum of £1. Barry refused to do this, and re-connected the lighting circuits to the mains himself. Mr. O'Reilly, for defendant, said that his client had offered to pay the cost of the excess energy used, but refused to recognise the Council's power to fine him £1. The magistrate made an order fining defendant £5, with costs amounting to £3.

Watson, Marsh & Co. *v.* Cope.

At Marylebone County Court, before Judge Sir Walworth H. Roberts, Watson, Marsh & Co., electrical engineers, of Golders Green, sued Victor Cope, an agent, of Golders Green, for £17 11s., work done and materials supplied in connection with alterations to an electric cooking set. There was a counter-claim for the return of £15 paid on the purchase of the set.

According to the evidence, the plaintiffs had organised a demonstration of the cooking sets at their premises, and the defendant was one of the purchasers. After a time defendant complained that the stove would not cook quickly enough, and plaintiffs undertook to have some work carried out which would improve it. The set was made use of for the kitchen, dining room and breakfast room. It consisted of an oven, boiling plate and grill; the price paid for it was £25, and the defendant's contention was that the £17 10s. sued for was included in the £25 originally paid for the article. The manufacturers were the British Electric Transformer Co.

Evidence given for the defence was that the cooking was so slow that the oven had to be started about an hour before it would cook anything, and it required half an hour to boil an egg and three-quarters of an hour to cook a joint.

The Judge held that the repairs to the cooking set were not included in the £25 which was given for it, and gave judgment for the plaintiffs on the claim and counter-claim with costs.

THE PROPOSED ENGINEERS' CLUB FOR LONDON.

In view of the steady inflow of letters from supporters of the proposal to establish a London club for engineers, it is considered that the time is now ripe to hold a meeting of the Provisional Committee, which is accordingly being called for February 10th. It is hoped that at that meeting an Executive Committee will be formed, with instructions to proceed with the preliminary inquiries, &c., and to report at the earliest possible date. The following gentlemen have consented to serve on the Provisional Committee:—

W. A. Agnew; A. H. Allen, M.I.E.E.; Llewellyn B. Atkinson, M.I.E.E. (president Institution of Electrical Engineers); Daniel Adamson, M.Inst.C.E., M.I.Mech.E.; Col. O. C. Armstrong, D.S.O. (president British Engineers' Association); H. E. Blain; Thomas Bolton; A. L. Churchill; Sir Dugald Clerk, K.B.E., D.Sc., F.R.S. (vice-president Institution of Mechanical Engineers; past-president Institution of Gas Engineers); A. C. Cramb, M.I.Mech.E., M.I.E.E. (hon. secretary Incorporated Municipal Electrical Association); E. C. Clark; C. T. Colpitts; J. F. Crowley, D.Sc., M.I.E.E.; Fred J. Dixon, M.Inst.C.E., M.I.Mech.E. (president Institution of Water Engineers); F. R. Davenport, M.I.E.E.; C. Dally; Howard Foulds; Alan R. Fenn; J. Fearn, A.M.I.Mech.E.; T. Goulden, M.Inst.C.E. (president Institution of Gas Engineers); Dr. E. Hopkinson, M.P., M.I.Mech.E. (past-president Institution of Mechanical Engineers); R. W. Hughman; Sir Robert Hadfield, Bart., D.Sc., F.R.S., M.Inst.C.E., (vice-president Institution of Mechanical Engineers); Edmund L. Hill, M.I.Mech.E., M.I.E.E.; Dr. H. S. Hele-Shaw, LL.D., F.R.S., M.I.Mech.E.; W. L. Hichens; W. W. Hughes, A.M.I.E.E.; Brig.-Gen. G. M. Jackson; Major C. W. Jordan, A.M.I.Mech.E., M.I.A.E.; F. W. Jennings; Bailie John King; G. Layton, M.I.E.E.; Max Muspratt; H. Mensforth, C.B.E., M.Sc. (Director-General of Government Factories); Brig.-Gen. The Lord Montagu of Beaulieu, K.C.I.E., C.S.I; S. Thornley Mott; E. Manville, M.P., M.I.E.E. (past-president Society of Motor Manufacturers and Traders); Ben H. Morgan; H. J. S. Mackay; Frank Merricks (president Institution of Mining and Metallurgy); Frank W. Mellowes; C. H. Merz, M.Inst.C.E., M.I.E.E.; Edwin L. Orde, M.I.Mech.E. (past-president N.E. Coast Institution of Engineers and Shipbuilders); F. Handley Page; P. C. Pope, A.M.I.E.E.; W. Prescott, B.Sc.; T. C. Pulman, M.I.Mech.E.; T. Peterson; Sir W. Peter Rylands (president Federation of British Industries); H. Richardson (hon. sec. The Engineers' Club, Manchester); Sir Harry Renwick, K.B.E.; H. C. B. Sainsbury, M.I.Mech.E.; J. D. Siddeley; Norman Scorgie, M.Inst.C.E.; S. Tweedale; H. C. B. Underdown (president Association of British Motor and Allied Manufacturers); J. S. Webb; H. T. Wilkinson, M.I.E.E. (The Engineers' Club, Manchester); C. H. Wordingham, C.B.E., M.Inst.C.E., M.I.Mech.E. (past-president Institution of Electrical Engineers); Ald. W. Walker, A.M.I.E.E.; David Wilson, C.B.E.; W. J. U. Woolcock, M.P. (Association of British Chemical Manufacturers); H. James Yates, M.I.Mech.E.

THE INDUSTRIAL SITUATION IN GERMANY IN 1920.

The Department of Overseas Trade has issued a "General Report on the Industrial and Economic Situation in Germany in December, 1920," by Mr. J. W. F. Thelwall, commercial secretary to H.M. Embassy, Berlin, assisted by Mr. C. J. Kavanagh, British commercial secretary, Occupied Territories, Cologne. It may be of interest to supplement the comments made in our editorial columns by the reproduction of the following additional information from the report.

The commercial secretary at Berlin, dealing with the outlook, states that at present German trade and industry are suffering severe losses through the fall in the world's prices for such commodities as cotton and copper, as the stocks, bought in the course of the year, are correspondingly depreciated. Should there be no recovery, the effects will show themselves in due course in the form of failures and financial embarrassment. Another factor which will have an adverse effect on trade in 1921 is the increasing burden of taxation, as the full force of the legislation of 1919 will begin to be felt in the first quarter of the year.

On the other hand, the commercial secretary concludes from his survey that German trade and industry are sound enough in themselves; their adaptability has seen them through the great hardships of two exceedingly difficult years, and as far as in them lay they have removed or surmounted the obstacles which impeded them. There is, however, one danger which they were not able to remove, and that is the bankruptcy of the country. Last year this was one of the several factors which warranted the assumption that Germany was threatened with collapse; this year it is the only one, but it is not likely to bring about this disaster, as neither Germany herself nor anyone else has any interest in its occurrence. It is therefore necessary to check the process of inflation.

Iron and Steel Industries.

The commercial secretary at Cologne states that Germany, with her reduced capacity of production within her present territories, will require all the pig iron and semi-finished steel produced in the country for her own requirements in working up into the most highly finished products, and will therefore in future, in contradistinction to formerly, have no materials of these kinds available for export.

The present rate of production of pig iron is not stated, as no statistics are now being published, but an analysis of such company reports for the year 1919-20 as contain any figures leads to the belief that a 60 per cent. yield is being obtained. On the other hand, the make of steel is considerably greater than that of pig iron owing to the importation of material from abroad and the utilisation of scrap iron on a large scale.

The labour situation is described as favourable. The actual productive capacity of the men has improved, and is likely further to increase given settled conditions. It is estimated that wages increases represent an advance over 1913 rates of from 10 to 15 times per ton of output, the influencing factors, beyond actual augmentation in wages, being the 8-hour day, additional holidays, decrease in working capacity, and diminution in the output.

The Engineering Trades.

Dealing with the engineering trades, the report states that the supply of raw materials has become more abundant, particularly cast iron and steel, owing to an improved home production, imports and also to a slump in the demand. The general stagnation in trade has not been without its effects in Germany, and it set in at a period of improved exchange when local products were consequently not cheap. Generally speaking, the outlook is dull, and the home demand is slack on account of the high prices.

The large increases in capital made have been due mainly to the high costs of procuring raw materials rather than to any extensions or installations of new plant. Apart from the transition of armament and munition firms to peace requirements, any reconstruction that is in progress has been chiefly in the direction of improvements to and the reconversion of boiler plant for burning lignite.

The increased importance of lignite has given rise to a brisk home demand for the special excavating and hauling machinery in use, as well as for light railway material. Boiler makers are also busy in the provision of special plant for the utilisation of crude lignite and lignite briquettes.

The export tax on engineering manufactures has been reduced to 3 per cent., which has stimulated exports. The report further mentions that the late coal strike and high prices in England and the inability of manufacturers to quote fixed prices and deliveries resulted in orders being placed in Germany for locomotives, oil mills, rolling mills and electrical plant. The tendency at one time to quote for export in foreign currency is not so much in evidence now, as with fluctuations in exchange losses have been frequent.

The annual reports of companies show that good dividends are being paid, and although shortage of raw materials and of fuel have had a depressing effect, the works in general have been fairly well occupied. The market is very receptive for foreign orders, and every effort is made to meet the requirements of customers.

A list of some of the combinations resulting from the regrouping of the industry is given in appendices, and it is also mentioned that the Augsburg-Nuremberg Engineering Co. has entered into a community of interests with the Gutehoffnungshutte (steel works), and that the Krupp Co. and the Rhenish Metal Ware Works have been added to the many existing makers of locomotives.

On the question of labour, the report states that the workmen are more or less contented in spite of the adverse conditions of living. Piece work is rather the exception than the rule, and the average wages per hour are from 7 to 8 marks, with an 8-hour day.

Non-ferrous Metals.

Concerning the branches for non-ferrous metals, the report states that the aluminium industry, which was largely developed during the war, is syndicated in the Ver. Aluminium Werke. Inland deposits of bauxite have been opened up, but it is believed that the inferior quality will be drawn upon more for chemical than for metallurgical purposes. The French export tax of 20 per cent. has diverted orders to the Dalmatian deposits, with which rail communication is still difficult, but shipments are stated to have taken place *via* Rotterdam. The demand for aluminium in the home market for domestic hardware has been brisk, and a good export trade in the former has resulted.

As a result of metallurgical research a magnesium alloy has been placed on the market under the name of "electron," which is said to contain more than 80 per cent. of magnesium, and to be suitable for light castings. The physical characteristics are a tenaile strength of 12 to 15 kg. per sq. mm. with an extension of 3 to 4 per cent. It is understood that the Griesheim Elektron Co. has entered into an agreement with the A.E.G. (Department of the Oberspree Metal Works) for the manufacture of commercial articles from this metal.

The copper, lead, nickel, and tin markets have established themselves as nearly as possible on former lines, while the zinc interests, beyond picking up odd parcels of concentrates, are merely expectant with regard to future developments in Australian supplies.

Lignite Power Stations.

The report, proceeding to refer to the question of electric power stations, states that considerable attention has recently been devoted to the problem of the economic generation of electric power from the large resources of lignite, which being of low calorific power and containing large percentages of moisture, cannot be transported over long distances. A solution has been found in the use of the lignite for generating electricity on the spot and its transmission to distant consumers by means of high-pressure feeders.

It is considered that these overland power transmission schemes, which went hand in hand with the development of the war industries, will play an important part in the future, and in the economy of generation and the saving in transport they have already materially assisted in tiding over a very difficult situation. During the war one of the country's super-power stations was erected at Knapsack, near Cologne. The installation is built on the lip of the lignite mine, and the lignite is fed mechanically from the open-cut excavating machines into the boiler house. The power developed is rated at present at 88,000 kW, generated at 7,000 volts, and stepped up to 110,000 volts for overhead transmission. The station is linked up with another at Reisholz by means of overhead transmission lines. The plant at the Knapsack station includes two 50,000-kW turbo-alternator sets which will shortly be placed in service.

The Golpa station near Bitterfeld, which is also located on lignite fields, has a capacity of 97,000 kW, of which 64,000 is transmitted at 88,000 volts to a nitrate works 16 miles distant, while the remainder is transmitted a distance of 80 miles at 110,000 volts.

The following are the most important of the extra high-pressure overland supply systems which are completed: (1) The State line from Bitterfeld-Golpa to Berlin of a length of 89 miles and comprising six aluminium conductors of 120 sq. mm. section. (2) The Rhenish Westphalian Electricity Co.'s line from Knapsack to Osterrath, of a length of 53 miles and with feeders of 18.6 miles; a second line between Grevenbroich and Reisholz of a length of 12.4 miles, the conductors being of aluminium and steel. (3) The Murgkraft works line between Forbach, Carlsruhe, and Mannheim, of a length of 72.5 miles, with cables of aluminium and steel. (4) The line of the Pfalz (Palatinate) works between Mannheim and Homburg, the length being 62 miles.

In addition to the above overland transmission lines are either in course of erection or projected of a total length of 992 miles, of which the Bavarian ring will represent over 620 miles. The remainder will be accounted for by the Saxony State lines, and by further extensions of the Bitterfeld-Golpa system to Leipzic and Magdeburg and the Grossenheim-Lauta-Berlin circuit, which will have a length of 122 miles.

JOINT ELECTRICITY AUTHORITIES.

Mersey and West Lancashire Inquiry.

An inquiry into the proposed formation of a Joint Electricity Authority under the Electricity (Supply) Act, 1919, for the above mentioned district, was opened at the Town Hall, Liverpool, on January 25th, by the Electricity Commissioners. Sir John Snell presided, and was accompanied by Sir Harry Haward, Mr. W. W. Lackie, and Mr. H. Booth, with Mr. E. W. Hudson (legal adviser), and Mr. D. S. Cumberlege (clerk).

The scheme put forward by the conference of supply authorities contemplated a capital outlay of £4,500,000, and involved the erection of a large generating station, probably in the Liverpool area, which would ultimately have a capacity of 250,000 kW, and the laying of transmission lines to the various areas. Among the matters which the Commissioners had to consider were the areas to be included in the proposed district and the objections by certain authorities on account of their inclusion or exclusion. An alternative scheme was submitted by Wallasey, which had the support of Birkenhead, for a separate authority for the Wirral district.*

The scheme presented to the Commissioners for approval embraced the towns and districts mentioned in our issue of July 23rd, 1920, p. 106, the whole covering an area of 613 square miles.

Mr. Honoratus Lloyd, K.C., who represented the promoting authorities, said some of the objections did not so much deal with the subject in a comprehensive way as try to obtain recognition of the continuance of the parochial and effete system from which they had suffered too long. It might be thought that the present was an inopportune time for spending money. But it was common knowledge if the industry of the country, and of that district in particular, was to receive the means of development of which it was so badly in need, immediate expenditure of money was necessary to produce the development of trade and economic working. If the trade of this country was to hold its own, there should be an ample supply of electricity for all purposes at the lowest possible cost. The many and various industries in those areas, Mr. Lloyd added, had of recent years extended enormously. That was likely to continue, and the supply of electricity was far behind the needs of those great industries. Some of the railways had already realised that electrification of their lines must come, and he could not think they would stand in the way of a public supply which would enable them to adopt or increase the use of electricity as a means of traction. The population of the area was 1,588,000, of which 1,270,000 were on the Lancashire side. Birkenhead had consistently dissented from the scheme; the Birkenhead stations, which were to be scrapped under the Wirral scheme, were some of the most inefficient and obsolete in the whole district.

In reply to the chairman, Mr. Lloyd said the technical officials of the Birkenhead Corporation had dissented from the scheme from the beginning.

Mr. A. T. Miller, for Birkenhead, said their view had always been that the Cheshire side of the river ought to be treated separately.

Mr. Lloyd said that Wallasey formerly supported the committee's scheme, but dissented for the first time on November 22nd. Continuing his address, he said it was proposed that the Joint Electricity Authority should comprise 30 members, of whom 12 should be appointed by certain local authorities, six by local authorities entitled to supply electricity, two by local authorities not entitled to supply, four by company undertakers, one by Mersey Docks and Harbour Board, two by the railway companies, and three by large consumers. They proposed ultimately to take over the whole of the generating plant in the district. The cost of generating under the new scheme would be much less than the existing power stations could hope to attain, but for some time the latter would have to continue in operation.

They desired at the first stage the interlinking of the main stations—Liverpool, Bootle, Birkenhead, Wallasey, Warrington, and St. Helens—and the provision of a capital station and high-pressure transmission mains. There was little doubt that eventually one capital station would be insufficient, and it might be that another would be required at a later date at Warrington, or on the Cheshire side of the Mersey. At the capital station it was proposed to generate at 6,600 volts and to transmit at 33,000, which would involve the use of transformers. They wanted transmission mains from Liverpool through the tunnel to Birkenhead (which could easily be extended to Ellesmere Port) and Wallasey; to Prescot and St. Helens; and Warrington. The last main could be easily linked up with the Mersey Power and the United Alkali Cos.' undertakings. It was not proposed as part of the first stage to link up Southport; there was a large agricultural district between, and it was not desired to carry a 33,000-volt main there unless the railways were likely to take advantage of it. At the capital station it was proposed to install four sets of 25,000 kW each, but the station should be capable of extension to ten such sets, with a total capacity of 250,000 kW. The estimated capital cost of the station, with four sets, would amount to £3,000,000, and the high-pressure transmission mains and transformers to £1,461,260, a total of roughly £4,500,000.

The opposition to the scheme on the Cheshire side came from Birkenhead, Wallasey, and the Mersey Power Co. (including the Runcorn Urban and Rural Councils and the Manchester Ship Canal Co.), whereas Northwich and Lymm desired to be included. In Lancashire, Southport wanted to remain out, and the British Insulated & Helsby Cable Co. objected to the whole scheme. Subject to certain clauses, the Mersey Dock Board, the Liverpool Chamber of Commerce, and the United Traders' Association of Liverpool supported the scheme.

Mr. Tyldesley Jones, K.C., for the railway companies, said they desired to suggest certain improvements in the interests of the railways, but with the desire to co-operate in whatever scheme the Commissioners thought was the right one. They were not there in an obstructive capacity.

Mr. Clothier, for the Bootle Corporation, said its approval of the scheme was qualified. It was held that consumers of electricity in Bootle would be better served by the extension of the borough's undertaking than by the adoption of the scheme, and the Corporation solicited approval of such an extension.

Mr. F. C. Wilson, chairman of the Liverpool Tramways and Electricity Committee, and of the conference of local authorities, gave evidence in support of the scheme, and stated that the establishment of a Joint Electricity Authority would help the trade not only of Liverpool, but also of the whole of the south-west of Lancashire, and Cheshire. The Mersey could not be treated as a frontier. Cross-examined by Mr. Miller, he said the Joint Authority was intended to take over the central generating station and the existing stations as soon as possible. He could not give a date. They looked for support to the local authorities concerned, but had not obtained from them promises of financial support. They also hoped for assistance from the Ministry of Transport. In reply to Mr. E. Tyldesley Jones, K.C., he said the amount to be provided from public funds had not been stated as yet. If it were not forthcoming, they would have to reconsider their position. On the question whether an undertaking would be given to provide an effective supply, Mr. Lloyd remarked that that would be offered later. Mr. Wilson said he believed four out of six urban districts of Wirral were in favour of the scheme. He believed the public would invest in the proposed undertaking. In reply to Dr. Eastham, for the Manchester Ship Canal Co., the witness could not say when the scheme would be linked up with the Mersey Power Co. (which supplied the Canal Co.), though in the meantime the Joint Authority would be in control. He agreed with Mr. Clothier that local authorities whose representatives attended the conference could withhold their assent if they chose, and with regard to the fact that the Corporation of Liverpool was seeking Parliamentary powers for extensions, he said the Corporation might require those powers before the Joint Authority was formed.

Mr. J. A. Jarrett, town clerk of Southport, said that borough was in no way desirous of marring a scheme essential to Liverpool, but suggested that the exclusion of that distant area would make no material difference to the prospects of the Mersey side.

Sir Harry Haward, one of the Commissioners, asked if the actual taking-over of the generating stations was essential to the satisfactory working of the scheme. Mr. Wilson replied that they must come under the control of the Joint Authority, which would have to buy them out. He did not think that control over the working of the stations without taking them over would be satisfactory. Most of the capital required would be needed for extensions even if there were no scheme.

Mr. Harold Dickinson (city electrical engineer, Liverpool) had begun his evidence in support of the scheme, when the inquiry was adjourned.

On Wednesday, Sir John Snell said the Commissioners desired to know what would be the amount required for extensions of individual undertakings if no scheme were brought into being, and he asked whether the promoters of the rival schemes had combined the actual load curves of the various undertakings, in order to ascertain the effect of bringing all the loads into one system. The Commissioners had done this in the first instance, and found that a maximum load of 51,000 kW would suffice instead of 70,000 kW.

Mr. Harold Dickinson, continuing his evidence, said the scheme would be of great assistance to the railways, and would facilitate their further electrification. It should be carried out in stages, the first step being the linking-up of the stations at Liverpool, Bootle, St. Helens, Birkenhead, Wallasey, and Warrington; as nearly all of them were short of plant, a new capital station should be provided on the river side. The Mersey Power Co. had refused to co-operate with the conference, and had not been included in the scheme; the company had furnished no information with regard to its undertaking. Mr. Dickinson proceeded to deal with the extensions which various undertakings would need to meet their estimated demands in 1925. He put the cost of providing the plant necessary for these extensions at £25 per kW, which was much below what it actually would cost. By 1925 new plant to produce 144,000 kW would be required by the various authorities in the area. The maximum load then he estimated at 156,000 kW, and the capacity with authorised extensions at 101,000 kW. The extensions necessary to produce 144,000 kW (at £25 per kW) would come to £3,600,000. The cost of the new capital station under the scheme (100,000 kW at £30 per kW) was £3,000,000, and the cost of the transmission system £1,461,260, a total of £4,461,260. The annual balance sheet under the individual extensions would show a

* Elec. Rev., January 7th, p. 10.

total expenditure of £1,986,610, compared with which the capital station scheme would result in an annual saving of £276,900, chiefly in coal and working costs, the total being only £1,709,710.

Sir John Snell pointed out that the witness had underestimated the benefit to be derived from the scheme, and remarked that engineers should put before the Commissioners information which was more likely to be borne out in practice.

Mr. Dickinson went on to say that as time progressed, the saving would become more and more pronounced, and there were other advantages to be borne in mind, such as the saving of coal. In 1925, he estimated, the individual undertakings would be distributing about 460,000,000 units. His scheme was that the load should be carried at the New Riverside capital generating station, Lister Drive, and Warrington. The other stations would not be entirely shut down, but held in reserve.

Sir John Snell said the Commissioners would like particulars of the programme proposed; how much would be done in the first, second, and third year, how much money would be spent, and how the expenditure would be met.

Mr. Dickinson said the combined demand of 460,000,000 units would be divided as follows: Liverpool, 233,600,000; Warrington, 58,400,000; St. Helens, 52,560,000; Wallasey, 35,040,000; Birkenhead, 32,120,000; Bootle, 29,200,000; Prescot, 18,396,000; District Lighting Co., 1,000,000. In the calculations a load factor of 33⅓ had been taken, except in the case of St. Helens, where it was 40, and Prescot, where it was 30 per cent.

In reply to Mr. A. T. Miller, K.C., the witness said he had not included any figure for the capitalised interest during the period of construction of the capital station.

Sir John Snell (chairman) inquired at the opening of the third day's sitting whether the promoters of the scheme were prepared to submit a statement asked for the previous day showing the construction and financial programme of each of the first three or four years, and indicating what work would be done in each year, what money it would cost, how it would be raised, and so on.

Mr. Lloyd replied that they had had a terrible night trying to comply with the request, but they found it was quite impossible. Until the Joint Authority was established and was able to ascertain precisely the extent of co-operation to be expected from the local authorities, any figures put forward might be purely fanciful.

Sir John Snell said it had not been indicated how the transfer of generating stations would be effected, and Mr. Lloyd said it could be arranged by co-operation, but the local authorities would not be dictated to by Liverpool.

Continuing his evidence, Mr. Dickinson, in reply to Mr. Jones, said that in Liverpool the annual supply was 95 units per head of the population. Mr. Jones said that after only eight years' working the Mersey Power Co. was supplying 369 units per head in its area. In reply to Sir John Snell, who remarked that all the witnesses should give all the figures in their possession without reservation, Mr. Dickinson pointed out that he had a great mass of figures, and it was very difficult to answer questions instantly; he had no intention of withholding information from anyone. He assumed that by 1930 the Mersey Co. would have been taken over, and would be supplying 11,000,000 units per annum to the joint system, while the United Alkali Co., on the other side of the river, would supply 58,000,000 units. Unless the Joint Authority owned and controlled all the undertakings his figures would not apply. Asked by Mr. Jones whether, in April last, he told the company that if it did not come in the Commissioners would refuse permission for extensions, Mr. Dickinson denied recollection of the remark, and said that it certainly was not used as a threat. In reply to Dr. Eastham, he said the estimated saving of £120,740 on coal was based on a figure of £2 a ton. He agreed that if the Commissioners limited the area to the north side of the Mersey, they could link up with the south side at a later date.

Mr. Jalland (for the United Alkali Co.) said that the company was willing to hand over its station or to supply energy in bulk; it seemed clear that an advantage would result under the scheme. Mr. Jones pointed out that if the company's station was transferred to the Joint Authority, the latter could not supply energy to the company, because it was in the Mersey Power Co.'s area.

In reply to Mr. Clothier (Bootle) and Mr. Jarrett (Southport), Mr. Dickinson stated that he had not made allowance for payments already made for the extinction of debt. Mr. Jeeves suggested that the rateable value of the new station, to cost £3,000,000, would not be £40,000 but 5 per cent., and that the rates would amount to £120,000 instead of £21,000. No allowance had been made for rates on the transmission mains, costing £1,500,000.

Mr. Dickinson, re-examined by Mr. Lloyd, said that co-operation was the essence of the scheme; if it were to be regarded as merely providing a stand-by supply, he would wash his hands of it. In reply to Sir John Snell, he said there was no difficulty or risk in laying transmission mains through the Mersey tunnel. He thought the omission of Southport would not injure the scheme.

Mr. Charles D. Taite (engineer and manager to the Lancashire Power Co., and formerly electrical engineer to Southport and Salford) thought the scheme was very necessary for the Merseyside and West Lancashire area, which in many respects was backward in electrical development. The costs in the various stations were undoubtedly too high. The majority, if not all, of the undertakings were short of plant and were expecting a big demand on their resources. A very excellent site was available on the river side. No division could be based on the Mersey, having regard to the existence of the tunnel, and there was no reason for separating the proposed area into two districts. That would be a most unfortunate thing, for both sides of the river were part of one commercial district likely to develop simultaneously. Witness added that it was quite time parochial boundaries in these matters were abolished, and a comprehensive scheme should be prepared for the whole of a district which had a common interest.

[The inquiry was continued on Friday and Saturday, and was adjourned to a date to be fixed, not before the end of February.]

(To be concluded.)

BUSINESS NOTES.

Bankruptcy Proceedings. — David Suchostawer, 1, First Avenue, Acton, Middlesex, engineer.—The first meeting of the creditors of the above was held on Wednesday, at the offices of the Official Receiver, 14, Bedford Row, London, W.C. According to the statement of affairs lodged by the debtor, the liabilities amounted to £1,030, of which £780 was expected to rank for dividend. The assets consisted of book-debts valued at £2, or a deficiency of £778. Book-debts of the face value of £1 038 were set down as bad. It appeared that the debtor, a Russian, came to this country some years ago, when he formed a company called the S.P. Syndicate, Ltd., for the purpose of exploiting a patent for the surface-contact system of tramways. That company, the debtor stated, was wound up six or seven years ago. He then formed another company, called Electric Magneto Motors, Ltd., for exploiting patents connected with general electrical work. That company was still in existence. The debtor attributed his present position to the failure of a company to fulfil its engagements with him. The Official Receiver (Mr. T. Gourlay), who presided, pointed out that the case was a summary one. No resolutions were passed, and therefore the estate remains in the hands of the Official Receiver.

James Sherred Denley, trading as Denley & Co., 69, Regent Street, Cheltenham, electrician and cycle dealer.—The receiving order in this matter was made on January 7th, on debtor's own petition. The statement of affairs showed unsecured liabilities of £113, against net assets £41, or a deficiency of £72. The debtor attributed his position to want of capital, loss on contracts, bad trade, and not having a practical knowledge of the business. It appeared that the debtor commenced business in partnership with two others on July 7th, 1919. His two partners were electricians, but except such experience as he had gained as a sapper while serving in the Royal Engineers, he had no previous experience of the business. When commencing the business, capital to the amount of £90, which was provided by the three partners in equal shares, was put into the concern. On October 7th, 1919, the debtor received £40 for arrears of Army pay, and on December 29th obtained a grant of £50 from the Civil Liabilities Fund, both of which sums were put into the business, as was also a sum of £21, part of £50 granted to the debtor in October last in lieu of pension. The two partners subsequently left the business, but there was no dissolution of partnership.

A. Lord, electrical contractor, 33, Westgate Burnley.—Receiving order made January 25th, on debtor's own petition.

William Drysdale, 24, Paxton Street, Barrow-in-Furness, electrician. The public examination takes place on February 11th. The following is a list of creditors of £10 and over:—

	£ s.		£ s.
Albion Electrical Stores ..	26 12	Forman & Sons	12 12
L. Andrew & Co.	42 15	General Electric Co.	24 7
— Appletons	25 5	H. & G. C. Lewtas	10 4
Barrow Builders' Association	14 4	P. K. Lee	35 9
Baxendale Bros.	76 5	Metro.-Vickers Elec. Co., Ltd.	15 19
Belling & Co.	20 12	H. G. Mabbs & Son	20 12
Barrow News and Mail, Ltd.	24 12	Millard Bros.	106 5
Callender's Cable & Con. Co.	184 3	J. W. Osborne	217 10
Geo. Casperson	16 8	Royal Accumulator Co. ..	33 18
Carron, Ltd.	10 19	Sloan Electrical Co.	41 6
Central Supplies Co.	32 15	J. & W. B. Smith	42 17
Dowsing Radiant Heat Co. ..	27 6	W. R. Thornton & Sons, Ltd.	207 17
Drapers' Association	20 10	Underwood, Ltd.	11 13
Downes & Davies	264 16	P. Webber	17 18
English Elec. Supplies, Ltd.	18 4	Wigan Coal and Iron Co. ..	11 5
E.G.S. Co.	31 13	Ward & Goldstone	121 10
Falk, Stadelmann & Co. ..	88 11		

Company Liquidation.—Electro-Chemical Developments, Ltd.—Particulars of claims must be sent to the liquidator, Mr. E. A. Ashcroft, 65, London Wall, E.C., by March 1st.

Dissolution of Partnership. — Tripp & Carryatt, motor, electrical, and general engineers, 59A, Alma Road, Clifton, Bristol.—Mr. E. J. Tripp and Mr. R. I. H. Carryatt have dissolved partnership. Debts will be attended to by Mr. E. J. Tripp, who will continue the business.

Trade Announcements.—THE SCOTTISH ELECTRIC LAMP REPAIRING CO., LTD., has leased premises in Paisley as a workshop and substantial stores, which will afford facilities for loading and unloading. The establishment is close to the railway. The company proposes to take the business in Scotland of the Allies Electric Lamp Repairing Co., Hammersmith. The orders at present embrace over 200,000 lamps.

THE CONSOLIDATED PNEUMATIC TOOL CO., LTD., of 170, Piccadilly, London, W. 1, have appointed Messrs. J. A. Angus, Kaims Foundry, Strand Road, Rangoon, Burma, their agents for Burma. Messrs. Angus will handle the company's air compressors, pneumatic and electric tools, rock drills, and all the accessories connected with the use of these appliances. They will also carry a stock of machines and spare parts, in order to give adequate service to users of the company's products in Burma.

MR. F. HUSBAND is representing Messrs. Fillery Frères & Cie., of Paris, and all communications should be addressed to him at 4, Grange Road, Chiswick, W. 4. The French firm is making a speciality of turned-wood accessories, such as bell pushes, wall rosettes, pear pushes, and adapters, as well as moulded insulating material to customers' requirements. Mr. Husband is also specialising in switchgear and motors.

We understand that MR. OSWALD L. RECORD has now left the Electrical Engineering and Equipment Co., Ltd., of 109, New Oxford Street, W.C. 1. For the present all communications should be addressed to him at Dacre House, Victoria Street, S.W. 1. Telephone : Victoria 2728.

THE WESTMINSTER TOOL AND ELECTRIC CO., of Putney Bridge Road, have appointed Messrs. R. S. Newton & Co., 29, Fountain Street, Manchester, as agents for the county of Lancashire for their "Westool" electric portable drills and blowers.

Messrs. H. W. Smith & Co. (1920). Ltd., have appointed MR. ASHLEY P. POPE as sales manager. His headquarters will be at their London office, Central House, Kingsway. Telegraphic address : "Virwires - Westcent - London." Telephone number : "Regent 2368."

With reference to the dissolution of partnership of Mr. E. J. Bailey and Mr. W. N. Smart, the latter announces that the business is being carried on by him under the title W. N. SMART AND CO., at 17, 19 and 19A, Cross Street, Oldham.

KENT BROS. ELECTRIC WIRE CO., of Charlton, S.E. (formerly the Eastcombe Engineering and Trading Co., manufacturers of cotton-covered copper wires, have appointed the following sole selling representatives :—England and Wales :—Mr. E. H. Phillips, 172, Wardour Street, Oxford Street, London, W. 1 ; Scotland : Messrs. W. Brown & Co., 200-208A, St Vincent Street, Glasgow.

The Times states that SIR CHARLES PARSONS, having acquired, as from January 1st, a controlling interest in the optical and scientific instrument firm of Ross, Ltd., will shortly join the board as chairman. Mr. John Stuart remains on the board.

Catalogues and Lists.—MESSRS. J. & W. B. SMITH, LTD., 15-23, Farringdon Road, E.C. 1.—An illustrated price list of "Glasmi" electric fires of various sizes and types, electric irons, hot-plates and cooking apparatus.

MESSRS. THOMAS BROADBENT & SONS, LTD., Central Ironworks, Huddersfield.—An illustrated leaflet, showing a number of applications of automatic centrifugal clutches to mill machinery, &c.

THE WARDLE ENGINEERING CO., LTD., Manchester.—A postcard advising consultation with the firm on all matters concerning scientific illumination.

MESSRS HIGGS BROS., Sand Pits, Birmingham.—Monthly magazine, Vol. II, No. 11. Stock lists of a.c. motors and d.c. dynamos and motors ; notes on speed regulation of motors, as well as the usual humorous items.

MESSRS. MANSELL & OGAN, LTD., 15-17, Cecil Court, Charing Cross Road, W.C. 2.—An illustrated and priced leaflet dealing with various sizes and ratings of "Cecil" fan regulators. A specification appears on the reverse of the leaflet.

THE CAMBRIDGE AND PAUL INSTRUMENT CO., LTD., 45, Grosvenor Place, S.W. 1.—A folder, "Instruments for Power Plants," giving a view of a power station, and showing a number of instruments in position. Separate illustrations of the instruments are also given, including distance thermometers, draught gauge, CO_2 recorder, &c.

NEW BRITISH ELECTRIC SUPPLY CO., LTD., Finsbury Court, Finsbury Pavement, E.C. 2.—An illustrated leaflet dealing with "Emcol" totally-enclosed motors. Descriptions are also given in French and Spanish.

THE LEA RECORDER CO., LTD., 28, Deansgate, Manchester.—Booklet M2, "Business in the Boiler House," by J. E. Lea, B.Sc., M.I.Mech.E. (12 pp.).—This publication contains copious notes on efficient steam production, boiler testing &c. A specimen boiler log sheet is enclosed.

MESSRS. WARD & GOLDSTONE, LTD., Frederick Road, Pendleton, Manchester.—An illustrated leaflet dealing with the "Reliable" transformer for use on bell and similar circuits, and also with the "Securitas" asbestos-lined fire preventer for attachment to flexible leads to retard the action of fire.

THE VAUGHAN CRANE CO., LTD., Openshaw, Manchester.—Booklet No. 8 (39 pp.), a profusely illustrated list of "Vaughan" cranes of various types, including both electric and hand-power cranes.

THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—Descriptive list No. 2420-B. (36 pp.).—A very detailed description of rotary converters manufactured by the B.T.H. Co., with a large number of illustrations and diagrams.

THE BRITISH THOMSON-HOUSTON CO., LTD., Mazda House, 77, Upper Thames Street, E.C. 4. Price list No. 10540-A, "Semi-Indirect Lighting Fittings" (16 pp.).—A well-illustrated catalogue of bowl fittings of various types with views of offices and shops in which these fittings have been installed.

THE EDISON SWAN ELECTRIC CO., LTD., Ponder's End, Middlesex.—List No. C C 201, illustrating and describing "Ediswan" house service cut-outs ; List No. W W 203, an illustrated booklet dealing with l.p. junction boxes, straight through and three-way, as well as terminal boxes. A circular letter announcing reductions in the price of "Royal Ediswan" vacuum and gasfilled lamps, enclosing a list showing old and new prices.

Lists of reduced prices have also been received from THE GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, E.C. 4.

MESSRS. E. BROOK, LTD., Empress Works, Huddersfield. List 52.—A leaflet giving specification, ratings and prices of "Brock" a.c. mine motors.

MESSRS. MARSHALL & PLUMTREE, LTD., 20, High Holborn, W.C. 1.—An illustrated and priced folder, describing a universal current limiter for d.c. or a.c. circuits.

THE LONDON FACTORS AND AGENTS, LTD., 39, Parliament Street, Westminster, S.W. 1.—A circular-letter giving the efficiency in watts per c.p. and lumens per watt of various types of incandescent lamps.

THE OVERSEAS ENGINEERING CO., LTD., 163-5, Great Portland Street, W. 1.—List No. 66 (12 pp.) giving prices and particulars of "National" d.c. motors and dynamos for many purposes. The list is fully illustrated, and includes fractional h.p. motors. Also an illustrated price list (No. 97) of "Overseas" electric irons, grills and toasters, and hot plates ; and List No. 17 dealing with flour mills and "Overseas-Federal" ceiling fans.

Lead.—Under date January 29th, MESSRS. G. CAWSON AND CO. report :—"Although the total turnover during the week has been fairly satisfactory, there is no improvement in price to record. The position as to supplies remains unchanged. There is very little lead coming forward, and unless Continental shipments become larger, supplies are likely to remain very restricted. As the German Exchange continues to improve, it cannot pay them to ship lead unless at higher prices. The partial destruction of the Port Pirie Smelting Works by fire is likely to retard Australian shipments for some considerable period, so that it is impossible to say at present when fresh Australian lead will reach this country. Meanwhile the demand from China and Japan is as insistent as ever. Our Government, however, still refuse to supply this demand from stock. The general trade demand remains rather poor, but electrical works continue to take lead in fair quantities, and are likely to do so. The outlook points to a steady market without much change in prices unless some fresh unforeseen development arises."

MESSRS. JAMES FORSTER & Co. in their report, state :—"The market has not been particularly active, transactions amounting to about 4,000 tons, as against 3.000 last week. Consumers have been more in evidence, and sales have been made to them for the Spring months as well as for prompt. On the other hand, export business is very dull. The fire at Port Pirie, which we understand destroyed the Dwight roasting plant entirely, may indefinitely delay the resumption of supplies of Broken Hill lead. In fact, we understand that a quantity of pig lead has recently been sold for prompt shipment to Australia."

Decontrol of Coal.—The Government has decided to cancel on and from March 1st next, the Directions of the Board of Trade dated August 25th, 1920, as to pithead prices. This will afford a month in which buyers and sellers can readjust their arrangements so far as these may be necessary. All allocations or directions to collieries to supply specified districts or consumers, whether made by instruction of the Government or by District Coal and Coke Supplies Committees, will be abolished from the above date, and inland consumers will be free to purchase supplies from any available source, and through any channel. They should, therefore, at once proceed to make any arrangements necessary to secure their supplies after March 1st. All questions as to price, quality, conditions of sale and delivery, &c., will be matters for arrangement directly between buyers and sellers. So far as coal for foreign bunkers and export is concerned, the position remains as shown in the official notifications published on December 28th, 1920, and January 10th, 1921.

Manufacture of Meters in Australia.—With reference to our note of June 18th last, under the above heading, in which it was recorded that extreme difficulty was experienced in securing supplies of electricity meters, and that it was proposed to commence their manufacture locally, we are informed from a reliable source that English manufacturers are now receiving a fair share of the orders for meters for Australia, and that their manufacture locally has not as yet commenced.

Receiverships.—W. A. & R. J. JACOBS, LTD.—W. Bigland, of 171, New Bond Street, W. 1, ceased to act as receiver on January 11th, 1921. A. E. Newman, of 171, New Bond Street, W. 1, appointed receiver on January 13th, 1921, under powers contained in debenture dated July 29th, 1920.

Boxing Contest.—At the canteen of Messrs. Thwaites Bros., Ltd., electrical engineers, Bradford, a return boxing contest took place on January 26th, between the apprentices of that firm and those of the Phœnix Dynamo Manufacturing Co. (English Electric Co.), Ltd., Bradford. Seven contests of four rounds each were engaged in, and provided enjoyable sport for the contestants and a large gathering of supporters. On the aggregate, the Thwaites Bros.' fighters were the victors. Mr. Brown, of the Thwaites' Bros. trainers, gave an exhibition of ball punching.

Forthcoming Exhibitions.—The following exhibitions are being organised :—

Birmingham.—March 21st-May 21st.—National Trades and Industrial Exhibition.

London.—February 10th to 26th.—"Efficiency" Exhibition at Olympia.

London and Birmingham.—February 21st to March 4th.—British Industries Fair. *Glasgow.*—February 28th to March 11th.

London.—March and October.—Society of Motor Manufacturers and Traders at Olympia.

London.—April 1st to 30th.—Building Trades' Exhibition at Olympia.

London.—June 3rd to 17th.—Rubber Trades' Exhibition at Royal Agricultural Hall.

London.—July 4th to 15th.—London Fair and Market at Royal Agricultural Hall.

London.—September 7th to 28th.—Shipping, Engineering and Machinery Exhibition at Olympia.

London.—November 17th to 25th.—Public Works, Roads and Transport Exhibition.

London.—1923.—British Empire Exhibition.

Johannesburg.—March 9th to 16th.—Chemical, Metallurgical, and Mining Exhibition.

British Dominions.—1921.—Dominions Touring Exhibition (South Africa, Australia, Canada and New Zealand).

Basle.—May 28th to June 8th.—International Automobile Exhibition.

Barcelona—April 1st to 10th.—International Samples Fair.

Bandoeng (Java).—September 19th to October 9th.—Netherlands East Indies Fair.

Bordeaux.—June 15th to 30th.—International Samples Exhibition.

Brussels.—April 4th to 20th.—International Commercial Fair.

Ghent.—April 16th to June 14th.—International Exhibition of Architecture, Building, and Kindred Industries.

Iceland.—June.—World's Fair.

Lima.—June 1st to October 31st.—International Industrial Exhibition.

Peking.—March.—International Exhibition.

Prague.—February 28th to March 8th.—Fair and Exhibition.

Lyons.—March 1st to 15th.—Metallurgy, Engineering, Building, &c., Fair. See below.

Mexico.—September.—Commercial and Industrial Fair.

Milan.—April 12th to 27th.—International General Manufacturers' Fair.

Utrecht.—September 6th to 16th.—International Fair.

Buenos Aires.—1922.—International Exhibition.

Rio de Janeiro.—1922.—International Centenary Exhibition.

Exhibitions.—The Committee of the Lyons Fair, at its last meeting, decided to exclude both German and Rhine-province exhibitors from the March exhibition. Arrangements have been made for a display of exhibits of electric heating and ventilating apparatus.

An electrical fair is projected at Paris, from May 10th to 25th, in two halls on the Esplanade des Invalides. Electric heating apparatus for the house and workshop will be specially catered for, alternating and continuous current being provided.

P.O. Telephone Cable Contract.—Messrs. Johnson and Phillips, Ltd., of Charlton, have just received an order from the G.P.O. Engineering Department for a duplication of the London to Brighton trunk telephone cable laid by them in 1914. This cable consists of approximately 55 miles of 104 pair 70-lb. dry core, lead-covered cable, and is an addition to a considerable mileage of trunk telephone cable which the firm have in hand for other sections of the G.P.O. telephone system.

New Spanish Company.—La Sociedad Iberica de Construcciones Electricas is the name of a new company which has lately been formed in Bilbao, with a capital of 20,000,000 pesetas.

An Industrial Relations Department.—Another example of the progressiveness of the Commonwealth Edison Co., Chicago, one of the largest central station companies in the world, is the establishment of an Industrial Relations Department. The company has been investigating for some time a plan for employé representation, with the object of ensuring mutual understanding, fairness and harmony between the employés and the management. The result of this study has been the creation of an Industrial Relations Department. One of the general duties of the department will be to supervise in an impartial manner, as between the management and the employés, the development, introduction and operation of an employés' representative plan. The manager of industrial relations will have the administrative responsibility for developing and carrying out a comprehensive personnel and employment policy in the company service, and for the management of the units of the company organisation performing functions of personnel administration. A special section of the department will be devoted to the welfare of the women employés. —*Electrical Review* (Chicago).

U.S.A. Wages.—A Central News New York dispatch appearing in the *Daily Herald* says that the General Electric Co. at Schenectady has cut down the wages of its employés by 10 to 15 per cent.

E.P.D.—At the annual dinner of the Bath Chamber of Commerce, when the hampering effect of E.P.D. on trade was criticised, Capt. Foxcroft, M.P. for Bath, explained that the Chancellor of the Exchequer might be interested to know that in Spain the letters E.P.D. (*En Paz Descansa*) were inscribed upon tombstones, the Spanish equivalent of R.I.P.—*Evening News.*

Book Notices.—"Welfare Work" (the Journal of the Welfare Workers' Institute). Vol. II, No. 13. January, 1921.—This issue contains, among a number of interesting and useful articles on welfare work and kindred subjects, the general secretary's annual report. Miss Voysey, B.A., states that the Employment Bureau has developed rapidly, and the Information Bureau is kept busy by inquiries of all descriptions. The total membership of the Institute has reached 546. The necessity for facilities for training welfare workers is emphasised, and a report of the work done in this direction during the year is given. Evidence on the subject of the employment of women and young persons in industry was collected and laid before the Home Secretary's Committee dealing with the question.

British Standard Specification No. 136—1920, "Interim B.S. Terms and Definitions for Use in Connection with Automatic Telephone Systems" (7 pp.). London: Crosby Lockwood & Son. Price 1s. net. Post free, 1s. 2d.—This list has been prepared in conjunction with the G.P.O., the Telephone Manufacturers' Association, and the Relay Automatic Telephone Co., Ltd. Where the nomenclature differs from that employed in America, the American term is given in parentheses. Common abbreviations are also indicated.

"The Mining Electrical Engineer," Vol. I, No. 4. January, 1921. (30 pp.) Price 1s. net.—This issue includes an illustrated article on "The Anderson Boyes Works and Products," papers on electrical signals and telephones in mines, as well as reports of proceedings at the branches of the Association.

"Interference of Power Circuits with Telephone Circuits" (8 pp.), "The Electrical Properties of Three-phase Transmission Lines" (16 pp.), and "On a Theory of Fluid Friction and its Application to Hydraulics" (19 pp.). By E. Parry, B.Sc., M.Inst.C.E., M.I.E.E. Reprinted from the *English Electric Journal.*—In the first of these papers the engineer-in-chief of the English Electric Co., Ltd., gives curves and calculations of the effects of electrostatic and electromagnetic induction on telephone lines. The second paper has been prepared "primarily for the use of departmental officers in designing transmission lines, with the object of economising time and of standardising the method of calculation." A number of valuable tables are appended.

"Electrification of Railways." By H. F. Trewman. Pp. ix + 75, 13 figs. London: Sir I. Pitman & Sons. Price 2s. 6d. net.

"*Journal* of the American Institute of Electrical Engineers." Vol. XL, No. 1. January, 1921. New York: The Institute. Price $1.

"*Proceedings* of the South Wales Institute of Engineers." Vol. XXXXI, No. 2. Issued January 21st, 1921. Cardiff: The Institute. 10s.

Callender's Hospital Fund.—We have received a copy of the 18th annual report and statement of accounts of Callender's Hospital and Distress Fund, which were approved at a meeting held at the Belvedere Works on January 29th. A record sum was received in subscriptions during the year, and it was possible to increase amounts given to the various hospitals and other institutions. A large number of hospital and nursing home letters were issued, surgical appliances were distributed in cases of necessity, and financial and other assistance was given. The weekly subscription realised £762, against £362 in the previous year, largely due to the higher rate (2d. per week instead of 1d.).

The company gave a donation of £50, and several guineas apiece were subscribed by the directors and others. The awards to hospitals and other institutions were £640, as against £376 in the previous year.

Fall in Lamp Prices.—We are pleased to see that the prices of the lamps sold by "Association" firms are being substantially reduced, several new price lists having been sent us recently. The alteration took effect as from February 1st. The most noticeable feature is probably the decline in the prices of gasfilled lamps, the fall being as great as 28 per cent. in one case, that of the 100-W size.

The types affected are "Royal Ediswan," "Mazda," "Britannia," "Xcel," "Foster," "Osram," "Cosmos," "Elasta Pope," "Stearn," and "Z" lamps.

Birmingham and Midland Institute Exhibition.—At this exhibition, held from January 11th to 14th, the Edison Swan Electric Co. displayed an extensive range of X-ray apparatus, including their X-ray couch and complete equipment and other electro-medical apparatus, all of which was described in our issue of January 14th (p. 40).

Stoker Orders.—Amongst the more important of the Underfeed Stoker Co.'s recent sales, are the following to electric power stations :—Travelling grate stokers.—Manchester (4), Bradford (12), Melbourne (2), Falkirk (1), Midland Power Co. (3); various industrial concerns (21). Underfeed stokers, industrial concerns (17). Ash conveyors are being supplied to the Lancashire and Yorkshire Railway and other companies; and air heaters to the Northampton Electric Light Co.

Copper and Lead Prices.—Messrs. F. Smith & Co. report, February 1st :—Electrolytic copper bars, £77, £3 decrease; ditto sheets, no change; ditto wire rods, £93, £3 decrease; ditto h.c. wire, 11½d., ⅛ decrease; silicium bronze wire, 1s. 7½d., ½d. decrease.

Messrs. James & Shakespeare report, February 2nd :—Copper bars (best selected), sheets and rods, no change. English pig lead, £24 10s.; 10s. decrease on last week's quotation.

Sale.—At the Georgetown Factory disposal sale, concluded on Wednesday, last week, four 400-h.p. electric motors for submarines realised £400 each.

British Industries Fair (Birmingham), 1921.—This Fair, which is to be held at Castle Bromwich from February 21st to March 4th, shows every sign of being an even greater success than that of last year. Large numbers of inquiries are being received from Colonial and foreign buyers, and all indications go to show that the Fair will be well patronised from abroad. The exhibits themselves will be more comprehensive and far more representative of the various trades allotted to the section of the Fair than was the case in 1920. The Duke of York will be present on March 1st. The visit of a number of official foreign commercial missions invited to this country as guests of the Government, coincides with the date of the Fair, to which a visit will be paid on March 2nd. These missions represent about 16 foreign countries, and will be—while in Birmingham—the guests of the Council of the Fair. Intending visitors are recommended to make immediate application with regard to hotel accommodation, to the General Manager, 95, New Street, Birmingham.

Social.—The Southport Tramway and Vehicle Workers held a successful concert in the Tramway Workers' Hall, on January 27th, Mr. Lawrence presiding. The programme was a capital one, and much enjoyed. Additional pleasure was added to the evening's proceedings by the serving of refreshments kindly provided by Mr. H. Marshall.

For Sale.—By order of the Disposal Board, Ministry of Munitions, MESSRS. EADON & LOCKWOOD will offer by auction, on March 8th and following days, at H.M. Factory, Langwith, Derbyshire, valuable chemical and electric power plant, engineers' tools, electrical and other stores, including 1,000 and 1,500-h.p. vertical gas engines. The Disposal Board, Ministry of Munitions, is inviting public tenders for a 675-h.p. steam-driven electric generating plant lying at Ellesmere Port, Chester; and a semi-Diesel electric generating plant, lying at Chattis Hill Aerodrome, near Stockbridge, Hants. For particulars, see our advertisement pages to-day.

New French Companies.—The Etablissements Galopin et Cie. have been formed into a company, under the style of Société Nationale d'Entreprises Electrique, with a capital of 1,000,000 fr., and offices at 126, Rue de Province, Paris.

With a capital of 3,500,000 fr., the Etablissements Dieny et Lucas, have been constituted a company at Paris (Rue Taitbout, 50).

R. Despessailles, R. Labanowski et Cie. is the style of a company constituted at Paris (3, Rue Lenbonnet) for the importation and exportation of electrical material and specialities of all kinds. The capital is 150,000 fr.

The Société Française des Machines Marelli is a newly constituted branch of the Milan firm of Ercole Marelli, formed with a capital of 1,000,000 fr., to manufacture in France the specialities of the Italian firm in motors, dynamos, transformers, alternators, electric ventilators, centrifugal pumps, &c. Its offices are at 56, Boulevard Voltaire, Paris.

With the title of the Société Hydroélectrique "La Valentinoise," has been formed at Paris (Rue de Vienne, 5) a company with a capital of 1,000,000 fr., in 1,000 fr. shares, of which 250 are apportioned to MM. Saint Paul and Pellegrin, and 175 to Marshal Foch, G. Foch, and Mlle. J. Foch, as consideration for their assets.

There has been established at Paris (94, Rue de la Victoire) the Société de Production et d'Exportation "Siderurgiques," for the purpose of carrying out undertakings associated with the mining and the ironfoundry businesses, and the manufacture of electro-mechanical and other apparatus. Its capital is 200,000 fr.

There has been formed at Paris (10, Rue Mogader), the Société d'Electricité de la Région de Dunkerque, with a capital of 5,000,000 fr. in 500 fr. shares, of which 4,000 are allocated to the Compagnie Générale pour l'Eclairage et le Chauffage par le Gaz de Bruxelles as consideration for its assets. A strong French and Belgian board of management has been appointed.

At Saint Chamond (Loire), J. B. Perrin, Gargaire et Cie., have been constituted a company, with a capital of 140,000 fr., to carry out electric installations.

There has been formed at Paris, under the designation of the Appareillages Electriques Peerless, a company with 250,000 fr. capital, to undertake electric installations and the sale of electric apparatus and accessories. Its offices are at 29, Rue de Mont Cenis.

With a capital of 2,500,000 fr. the Société Anonyme des Etablissements Guinier has been registered a company at Paris (38, Rue de Trévise).

The Société des Forces Motrices de l'Ariège has been established at Paris (5, Rue Blanche), to develop the water power of the river Ariège in every possible way for the generation of electricity. Its capital is 12,000,000 fr.

Calendar.—MESSRS. CHARLES CHURCHILL & CO., LTD., of 9-15, Leonard Street, London, E.C. 2, have sent us a wall calendar with a block of daily date slips below a picture representing a works interior wherein machine-tool equipment and contented labour secure "production, the secret of prosperity."

Workshops Available.—A correspondent has room available at his works in Putney—shops of 147, 275, and 500 sq. ft.—for the manufacture of electrical appliances, such as meters with electric power, and would supervise the work if desired, or let the space. Inquiries sent to us will be forwarded.

Norwegian Cables for Russia!—It is reported from Drammen, Norway, that a local firm of agents, acting on behalf of the Soviet Government, is in negotiation with the Norsk Kabelfabrik in relation to the suggested delivery of a considerable quantity of telephone cable to Russia.

LIGHTING AND POWER NOTES.

Barrow.—ELECTRICITY SCHEMES.—The provision of electricity at Barrow is being debated by the Electricity Committee, which has already considered the suggestion to obtain power from the river Leven at Backbarrow, and also a proposal to make overtures to Messrs. Vickers, Ltd., for any surplus electricity from their new power station at Buccleuch Dock. The former scheme is estimated to cost £90,000. A third scheme has now been proposed to harness the tides at Walney Island, by which it is estimated a supply of electricity could be generated sufficient to supply Barrow and the whole area between Lancaster and South Cumberland. The main factor, however, is one of cost, which would be heavy. A report is being prepared, and this will come before the Committee.

Bedford.—LOAN.—The Town Council has applied for sanction to a loan of £1,600 for transformers, switchgear, &c., for extended supplies to the works of Messrs. J. & F. Howard, Ltd., and a sub-station is to be provided for the Queen's Park district, at a cost of £720.

Birkenhead.—LOAN.—The Town Council has decided to create the necessary stock for raising the sum of nearly £1,000,000, of which £28,000 is expenditure authorised by the Electricity Commissioners for the purpose of the electricity undertakings.

Blackpool.—HOUSE-WIRING.—The Corporation Housing Committee took no action with regard to a request from the Electrical Contractors' Association, London, that in connection with the work of wiring the Corporation houses for electric light only tenders from members of the Association should be considered. The tenders have been let to the Blackpool Electrical Association.

Bolton.—LOAN SANCTIONED.—The Electricity Commissioners have sanctioned the borrowing by the Town Council of the sum of £50,000 for mains and £50,000 for sub-stations on consumers' premises.

PROGRESS OF EXTENSIONS.—In a report on the progress of extensions at the Back-o'-th'-Bank station, the electrical engineer states that the 6,000-kW turbo-alternator is in course of erection. The engine-room for the first 12,000-kW set is well in hand, and a large part of the boiler-house steelwork is erected. The material for the four boilers in connection with this set is practically all ready on the site or completed at the makers' works. The 12,000-kW turbo-alternator is expected to be erected and ready for load in August. It is estimated that the total plant capacity will be 34,000 kW by next winter, including stand-by plant. The maximum load is estimated at 18,000 kW. The total cost of the extensions is given as £821,380, and expenditure to the date of the report amounted to £154,766.

Cassop.—PUBLIC LIGHTING.—The Council has accepted the offer of Messrs. Bell Bros., Ltd., of Bowburn Colliery, to erect poles, lamps, &c., for public lighting and supply electricity at £5 per lamp per annum.

Colchester.—PROPOSED PRICE INCREASE.—The Town Council has applied for an order to increase the price of electricity to 1s. per unit, with a quarterly payment of 15s. for any quantity up to 15 units for the winter quarters, and 10s. for any quantity up to 10 units for the summer quarters.

Continental.—FRANCE.—An official inquiry is being held into a scheme for establishing a high-pressure network for the distribution of energy from the waterfalls in the Tarentaise, Albertville and Beauges valleys, in the Lyons and Stephan districts. Two main lines are contemplated, which, with their several branches, will serve some 42 towns.

The Société des Forces Motrices de la Vienne is about to start working the station which has been in course of construction since 1917 at the Ile Jourdain, designed to supply at 60,000 volts on the various centres of the departments of Charente, Charente Inférieure and Deux Sèvres. The station only forms a part of the company's programme, which includes the erection of two other stations, one at Chardes, of 6,000 h.p., and the other at Joussand, of 9,000 h.p. capacity.

BELGIUM.—The municipal authorities of Ostend have taken over the concession for the electric lighting of Mariakerke from the Compagnie du Tramway Electrique d'Ostende-Littoral (in liquidation), and also the whole of the company's installation.

CZECHO-SLOVAKIA.—The Moravian Provincial Committee has decided to carry out a scheme for establishing a large power station on the River Thaya, which will generate 80,000,000 kWh per annum. The financing of the scheme, which will take several years to carry through, is now assured, a Swiss banking group having promised its assistance.—*Economic Review.*

Ealing.—LOAN.—The Town Council is applying for sanction to a loan of £30,000 to cover the following items of capital expenditure for the ensuing three years:—H.p. feeders, £12,500; l.p. distributors, £7,000; services, £3,000; meters, £5,000; and transformers, £2,500.

Fermoy.—ELECTRIC LIGHTING PROPOSED.—Owing to the excessive cost of gas—12s. 6d. per thousand cb. ft.—the Urban Council is to institute inquiries regarding an electricity supply for the town.

Hebden Bridge.—LOAN.—The Council is seeking sanction to the borrowing of £5,000 for the provision of additional mains and meters.

Kingston-on-Thames.—Loan Sanctioned.—The Town Council has received sanction to a loan of £14,230 for electricity purposes, and a further loan of £19,750 to meet excess expenditure on plant extensions has been applied for.

Lancaster.—Proposed Extensions.—In order to cope with the greatly increased demand for electricity, the electrical engineer has been instructed to prepare a report on the plant and suggestions for its extension. Inquiries are also to be made as to the possibility of obtaining a supply from the National Projectile Factory.

Leeds.—Street Lighting.—The Street Lighting Committee has decided that commencing September 30th next, three-quarters of the total number of the public lamps in the city shall be lighted. This will be equivalent to the lighting in pre-war days. Any special cases, where extra light is required, will be dealt with as deemed necessary.

London.—Stepney.—Under the general conditions of supply, "restricted" supplies have hitherto been given by separately-metered circuits provided with a time switch cutting off supplies between sunset and 7 p.m. from Monday to Friday during six winter months. Many premises, therefore, have double circuits, and the Electricity Supply Committee reports that it has discovered cases of consumers who have endeavoured to connect their supply to obtain electricity at the reduced "restricted" rate during the rest of the day. On this account it is recommended that the "restricted" supplies should be confined to certain classes of consumers, such as places of worship, shop exterior lighting, &c.

A scheme of extensions has been drawn up by the borough electrical engineer, which it is proposed to proceed with in three parts. The first instalment will cost £281,160; the second, £128,480; and the third, £82,500; making a total of £492,140. The Finance Committee recommends application to the Electricity Commissioners for sanction to a loan to cover the cost of the first part of the scheme.

Hammersmith.—With regard to the Council's application for sanction to a loan of £21,693 for electricity purposes, the Electricity Commissioners have consented to the borrowing of £16,635. An item of £305 is to be charged to revenue, while items of £500 for a sub-station site, and £400 for buildings have also been omitted, the first pending the settlement of negotiations, and the second because the Commissioners consider the amount should be charged against the amount of £900, sanctioned for the linking-up scheme.

St. Pancras.—Reporting to the Borough Council on the subject of supplying electricity to rooms in tenement houses, the Electricity Committee states that the chief electrical engineer, in accordance with instructions, has submitted three schemes for the extension of the public street lighting by electricity in different districts of the borough, and at the same time to provide small dwellings with electricity in accordance with the Council's scheme. Unfortunately these schemes do not provide for much labour, the greater proportion of the cost being for materials. The Committee has, however, adjourned the consideration of the matter in order that a canvass may be made of the districts to ascertain the extent of the demand for electricity for household lighting, particularly concentrating on those streets where mains are already laid or are in the immediate neighbourhood. The Council's scheme at the present time provides only for small dwellings, and is based upon six lights being used, whereas a large proportion of the streets now under consideration are composed of tenement houses in which each family occupies two or three rooms.

Monasterevan (Co. Kildare).—Sale of Plant.—Mr. T. Tynan, merchant, Ballybrittas, has purchased the plant of the Monasterevan Electric Light Co. for £1,500.

Morecambe.—House Lighting.—The Corporation has sanctioned the expenditure of £3,000 upon the laying of new mains to supply electricity to the houses in course of erection under the borough housing scheme.

New Zealand.—Wairoa Development.—H.M. Trade Commissioner in New Zealand reports to the Department of Overseas Trade that the ratepayers of the Wairoa district have approved the proposal of the Wairoa Electric Power Board to borrow the sum of £100,000 for the purpose of erecting main electric transmission and feeder lines between Waikaremoana and the Borough of Wairoa, including sub-stations and equipment (£35,000); erecting subsidiary transmission lines, feeders, and sub-stations from the main transmission line to outlying districts in Wairoa County (£60,000), and purchase of electric motors, machinery, fittings, &c. (£5,000).

Salford.—Issue of Stock.—The Town Council, at a special meeting, has decided to create stock for the raising of £750,000, £100,000 of which is for electricity purposes.

Southend.—Proposed Extensions.—At the Electricity and Light Railways Committee, the electrical engineer submitted a short report upon the question of the extensions of plant which he had advised should be carried out in order to be available by the summer of 1925, by which time he estimated that the load would be approximately 6,960 kW (the existing plant capacity, including the six new Diesels now in course of erection, being 5,960 kW), but that allowing for stand-by plant of 1,340 kW, the plant available at maximum load would only amount to 4,620 kW, which, in his opinion, would only be sufficient for the summer load of 1922. He reported that to provide for the summer of 1925, 8,200 kW, including stand-by plant, would be required, an addition of 2,240 kW to the plant now in course of erection, either by the purchase of four 540-kW Diesel sets, or the installation of one 2,000-kW or three 750-kW steam generators in the main station, with the necessary extension of the boiler-house plant, in order to raise its capacity to 120,000 lb. steam per hour. A special meeting of the Committee was to be held to consider the scheme, together with a scheme for the provision of turbo-alternators presented to the Committee in November last, the estimated cost being £300,000.

Stoke-on-Trent.— Extensions and Finance. — The Electricity Committee having recommended the borrowing of £200,000 for extensions, which the Finance Committee suggested should be deferred until after the end of the present financial year, owing to the serious financial position of the Council, the matter was discussed at a meeting of the Town Council. It was pointed out for the Electricity Committee that with the existing plant, the requirements of the district could not be adequately catered for beyond 1922, and that if the borrowing of the amount named were deferred, the responsibility for failure to meet the demand would be with the Council and not with the Committee. After discussion, it was decided to refer back the Finance Committee's proposal, and the matter is to come up again for consideration by a joint committee of the Finance Committee, and other committees concerned.

Todmorden.—Loan Sanctioned.—The Electricity Commissioners have given permission to the Corporation to borrow £31,000 for plant and mains in connection with a bulk supply from the Yorkshire Electric Power Co.

Wareham.—Special Order.—The Wareham Electric Supply Co., Ltd., is applying to the Electricity Commissioners for a special order authorising the company to distribute electrical energy for public and private purposes within the Borough of Wareham, and parts of the parishes of Arne and Wareham St. Martin.

Wrexham.—Loan.—The Town Council is seeking the permission of the Electricity Commissioners to borrow £20,176 for mains extensions, &c., including the provision of cables to the new houses at Acton Park.

TRAMWAY AND RAILWAY NOTES.

Burnley.—Fare Increase.—The Council has approved of a proposal of the Tramways Committee to raise the fares on the long distance journeys, with a view to reducing the anticipated deficit on the year's working. The Council has received an interim order from the Ministry of Transport sanctioning the increase.

Chester.— Condition of Track.—It was reported at the meeting of the Town Council that to put the tramway track in order would entail an expenditure of £70,000, and that some other method of conveyance, such as railless trolley cars or motors, was the only alternative. Tenders are to be invited from firms for running a motor-'bus service.

Continental.—Norway.— Information has been received in the Department of Overseas Trade that the Norwegian Government has granted a concession to A/S Akersbanerne to construct an electric railway from Majorstuen through Taasen to Sogn svandet, and from Taasen to Sogene, a suburb of Christiania. Preliminary work in connection with the levelling of the route is to be put in hand immediately. This will not, however, be concluded until next autumn, and invitations to tender will not be issued until the end of the year. Opportunity will then arise for British firms to submit tenders. It is estimated that the rails will be required at the end of 1922, and the cars in the autumn of the same year.

A/S Akersbanerne recently applied to the Norwegian Government for a further concession in respect of a prospective line from the centre of Christiania to Ostensjo, a distance of about 8 km. In the event of the concessions being granted, both lines will be built simultaneously, and further material will be required.

Spain.—The contract for the supply and erection of the installations in connection with the electrification of the Pajares incline on the Norte Railway between Gijon and Leon has been awarded to the Compagnie Française Thomson-Houston, of Paris, together with the General Electric Co., of New York. These two companies, in agreement with the Caminos de Hierro del Norte, are expected to obtain from Spanish industries as much of the material needed as possible. The railway company, moreover, is to contract, if possible, for the supply of power by the companies of the Pajares region, in order to dispense with the steam power station proposed by the French company, or at least to simplify it and use it only as a reserve in case of interruption in the supply of power from the hydro-electric establishments.—*Reuter's Trade Service* (Madrid).

Dewsbury.—Report on Improvements.—The Tramways Committee is to make a report to the Town Council as to possibilities and costs of alterations with a view to doing away with the present congestion of tramway termini in the centre of the town.

Durham County.—Transport Scheme.—At a special meeting of the County Council on January 26th, it was formally decided to proceed with the promotion of the Parliamentary Bill permitting the Council to inaugurate a large transport scheme. A great deal of opposition to the scheme had been put forward by local authorities in the area, as well as by business men who

consider the project will merely be a further burden to the ratepayers. Owing to the consent of local authorities to the construction of certain tramways being withheld, it is probable that the Examiner will refuse to permit the inclusion of these provisions in the Bill. If they are dropped, the cost of the proposals will be lessened by about £200,000.

Halifax.—Anemometer Stations.—Following upon the reports of Government inspectors on the recent blowing over of two tramcars on the high and exposed section of the tramway route at Queensbury, the Tramways Committee is making inquiries as to the cost of installing an anemometer station on one or more of the exposed routes of the town, to record the maximum wind velocities in the neighbourhood. A decision, in the meantime, that no double-deck cars shall be run on the Queensbury and other similarly exposed routes, has called forth a protest from the Queensbury District Council, which suggests that covered cars should be used when weather permits, and advocates the provision of a loop to the single line at a point less exposed than Stocks Gate, where the cars were blown over whilst standing. For the present, however, the Committee is adhering to its decision as to covered cars.

Distribution of Materials.—With a view to effecting economy and obtaining speedy delivery, the Tramways Committee has recommended the Municipal Tramways Association to purchase a bulk supply of rails for distribution amongst the authorities requiring them.

Loss in Working.—A financial statement for the nine months ending December 31st, 1920, shows that the Corporation tramways have been run at a loss of £5,959, as against a profit of £1,918 during the corresponding period of 1919.

Ipswich.—Electric Vehicles.—The Ministry of Health, on January 25th, inquired into the circumstances in which the Corporation is seeking sanction to a loan of £2,951 for the purchase of electric dust-collecting vehicles. In his evidence the borough surveyor said the present weekly cost of the horsed vehicles was £6 11s. for cart, horse, and man. The amount of refuse collected by each vehicle averaged just over seven tons per week, and the cost of collection was 18s. 3d. per ton. With the electric vehicles 85 tons of refuse could be collected per week, at a cost of £48 9s. 3d., or 11s. 4d. per ton. The annual saving was estimated at £1,500.

Leeds.—Proposed Increased Fares.—The Corporation is seeking powers to advance the tramway fares from 1d. to 1½d. per mile. Workmen's tickets will be abolished. The alterations are rendered necessary by the continued daily loss; for the nine months ending December 29th there was a deficit of £30,495, averaging £111 per day; latterly the position has improved a good deal, but the loss is still about £50 per day.

Liverpool.—Express Tramway Track.—The Tramways Committee, after reconsidering the scheme for the express tramway along Princes Road, which had been referred back by the City Council, confirmed its previous decision. The Council will, therefore, be recommended to lay the Princes Road tramway track on sleepers, at an estimated expenditure of £24,057, which is £2,800 less than would be incurred by laying the present track with setts.

London.—Report on Collision.—Major G. L. Hall, R.E., has submitted a report to the Ministry of Transport on the collision which occurred between an electric train and a steam train near Waterloo Station on November 26th last. The collision was only a slight one, the damage was small, and no personal injuries were sustained. From the evidence given it would appear that the responsibility for the accident rests with the driver of the steam locomotive, who either failed to observe the correct signals, or took those of another line to be his own. Major Hall concludes his report by saying that "The case is a typical example of an accident which would have been prevented by a system of automatic train control, and, as such, has been brought to the notice of the Committee."

A New "Tube" Device.—The Underground Companies have installed an "Automatic Stentorphone" at Oxford Circus Station. This device is a kind of gramophone which directs passengers ascending or descending by means of the escalator to keep moving, instead of standing in one position.

Newcastle-on-Tyne.—Loan.—At a meeting of the City Council on January 25th, the town clerk was instructed to make application to the Minister of Transport for sanction to borrow the following sums:—£42,740 for excess expenditure on the Benton tramways, and £16,000 for doubling a portion of the Longbenton track. Mr. G. G. Elliott, in moving the instruction, stated that the only alternatives to a loan were payment out of revenue, or out of the tramways reserve, neither of which was practicable.

Southport.—Stoppage of Traffic.—Traffic was held up for some time on the electric railway between Liverpool and Southport, on January 27th, as the result of the derailment of two wagons. Whilst the obstruction was being cleared, steam trains were run from Liverpool to Bookhall, and in this way, passengers were able to proceed to Southport and intermediate stations.

Warrington.—Extension.—At its February meeting the Warrington Town Council will be asked to accept tenders for the linking up of the Stockton Heath and Cemetery tramway routes. The greater part of the track was laid some years ago, and to effect the improvement in the tramway services all that is required is the laying of a curve extension, and the erection of the overhead equipment.

TELEGRAPH AND TELEPHONE NOTES.

France.—Wireless Communication with Bulgaria.—Wireless communication between Bulgaria and France has been established for private and Press correspondence. The fees are the same as those levied on ordinary lines, the messages bearing the words "non taxée: voie T.S.F." In case of overburdening or interruption of the wireless route, the offices concerned reserve the right of making use of the ordinary telegraph lines.

Italy.—Strike.—The postal and telegraph employés at Rome ceased work on January 27th.

Montevideo New Telephonic System.—The only tender received for the construction of a telephonic system in Montevideo was that of the International Eastern Electric Co., Inc., which offers to construct the underground telephonic system, together with the necessary works, offices, &c., for a maximum price of 6,943,500 pesos, and a minimum price of 6,647,000 pesos, according to the variations which it might be necessary to introduce in the course of the work. The initial lines would provide for a service to 16,500 subscribers, while extensions are in view providing for 46,500 subscribers and a connection with the telephone system of Buenos Aires.—*Reuter's Trade Service* (Montevideo).

New Telephone Exchanges.—A scheme which will take about 20 years to complete, proposes the equipment of 60 additional telephone exchanges in the London area. According to the *Evening News* the 30,000-line Tower exchange in Great Tower Street is nearing completion, and will probably be the first to be placed in operation. A temporary exchange, which is being constructed to relieve the congestion, will be out of the architects' hands this month. The Stratford exchange will be finished so far as the builders are concerned, in April, when its equipment will begin. The Holborn exchange, near Chancery Lane, is in an early stage of construction, but a temporary exchange near by will be in commission in a few months' time. The Berkeley exchange will relieve the pressure on Mayfair; it is being equipped, and sites have been selected for 13 other exchanges, including the Strand, Sloane, Golder's Green, Langham or Marylebone, Battersea, and Woolwich. The Strand exchange will deal with 30,000 lines, and will be situated near Covent Garden; a temporary Langham exchange is being erected on top of the Western District Post Office, and another is to be built in Queen's Road, Hendon, whilst a 30,000-line exchange is to be in installed in Wood Street, Cheapside.

A new automatic exchange is to be established at Blackfriars, and if successful it will be widely extended.

Last week the telephone services of Milnsbridge, near Huddersfield, were transferred from the old exchange in Armitage Road to the new building in George Street. This exchange should have been in operation long ago, but the work was held up by the war.

Norway.—Photo-telegraphy.—The newspapers at Christiania recently published detailed accounts of a demonstration, given at Sandefjord, of an improvement in telegraphy invented by M. Hermod Petersen, chief manager of the Radio Department of the Telegraph Service. According to *The Times*, the invention consists of a new system based on alternating current, instead of the d.c. system hitherto used. One of the many benefits which this invention is expected to bring is a big reduction in the number of operators needed. It is estimated that work which now requires 117 of the best operators in Norway could be done by 16. The new system eliminates errors, and reproduces with photographic accuracy, at practically unlimited distances, all sorts of handwriting, type, drawings and photographs.

Ships' Wireless.—New Emergency Device.—The Marconi Co. has produced a compact emergency wireless set with a transmitting radius of 50 miles which it is proposed to install on motor driven lifeboats. The set has been designed to work under rough-weather conditions and to remain reliable even if left inactive for a long period. The necessary operating adjustments have been reduced to a minimum, and the electrical and mechanical details have been made as simple as possible; the aerial is supported on two masts. The White Star Co. has ordered one of the newly-equipped motor-boats for the *Olympic*, and the Union Castle Co. is to install one on the *Arundel Castle*.—*Evening News*.

Wireless Telegraphy.—Railway Communication.—Experiments with wireless telegraphy as an auxiliary means of communication on railways have been conducted by the Marconi Co. between Euston and Crewe, and as soon as the Post Office grants a licence, apparatus will be submitted to the London and North-Western Railway Co. for the purpose of making extended trials under commercial conditions.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Aberdeen.—February 21st. Corporation Waterworks Department. Electrically-driven pumping machinery. Specifications, £5 (returnable), from Water Engineer's Office, 41½, Union Street, Aberdeen.

February 21st. Electricity Department. Temporary and permanent coal conveyors and shoots in connection with the reconstruction of the boiler house at Ferryhill. (January 21st.)

Australia.—Melbourne.—March 2nd and 9th. Victorian Railways. Reactances and condensers (for power signalling), electric crabs and equipment for cranes.*

Adelaide.—February 23rd. P.M.G.'s Department. Electric lamps, as per Schedule 561. (January 21st.)

Sydney.—March 21st. P.M.G.'s Department. Telephone and telegraph apparatus, testing instruments and switchboard parts, Schedule 814. (January 28th.)

Perth, W.A.—March 29th. P.M.G.'s Department. Telegraph accumulators, Schedule 333. (January 21st.)*

April 5th. P.M.G.'s Department. Accumulators, &c., for Eucla, W.A. (January 28th.)

Brisbane.—March 30th. P.M.G.'s Department. Switchboard apparatus and parts.*

Batley.—Co-operative Society. Electric lighting of Clerk Green store. Specifications from Secretary.

Belfast.—February 26th. Tramways Committee.—Tramway stores, including electrical accessories, cable, lamps, carbon brushes, &c. (January 28th.)

France.—Paris.—February 17th. The supply and installation of a multiple commutator table at the Central Telephonic Bureau in the Boulevard Raspail. Particulars from the Direction de l'Exploitation Téléphonique, 4e Bureau, 103, Rue de Grenelle, Paris.

Great Yarmouth.—February 11th. Electricity Department. Supply and erection of h.p. switchgear. (January 21st.)

Leicester.—February 19th. Electricity Department. Two 10,000-kW, 3-phase turbo-generators, with condensing plant; also screens for straining condensing water. (See this issue.)

London.—Battersea.—February 9th. Electricity Department. H.h.p. and d.c. switchgear for two 450-kW converters. (January 28th.)

Manchester.—February 14th. Electricity Department. 33,000-V trunk feeder, pilot and telephone cables. (January 21st.)

February 15th. Tramways Committee. Tramway stores, including meters, cable, lamps, bells, insulators, &c. (January 28th.)

Middlesbrough.—February 9th. Corporation. Double line of tramways from Albert Road to Linthorpe Road. Particulars from Mr. S. E. Burgess, Borough Engineer, Municipal Buildings.

New Zealand.—Wellington.—March 1st. Public Works Tender Board. Seven 4,000-kVA single-phase transformers, with accessories, for Lake Coleridge electric power scheme.*

March 5th. Government Railway Department. Two overhead travelling cranes.*

Salford.—February 14th. Tramways Committee. Twelve months' supply of miscellaneous stores. Particulars from General Manager, 32, Blackfriars Street.

South Africa.—Pretoria.—March 10th. Municipal Council. One 20-ton overhead crane, six boilers (350-lb. working pressure), three 3,000-kW steam turbo-generators with condensing plant, five 750-kW converters. Further particulars can be obtained from Mr. T. C. Wolley-Dod, general manager, electric lighting department. Specifications (five guineas) from the town clerk.

February 16th. One 1,000-kW rotary converter with transformers and switchgear.*

Swinton-Pendlebury.—Urban District Council. Electric lighting of houses on Temple Lodge estate. Specifications from J. Knight, architect, 5, Cross Street, Manchester.

Uruguay.—Monte Video.—March 29th. State Power House. Single and three-phase meters.*

February 21st. State Power House. Electrical accessories, including plug fuses, branching blocks, cut-outs, keys and switches.*

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—Telephone material for the various States for the P.M.G.'s Department:—

8,340 magneto wall telephones, £36,046; 740 do. table do., £4,482; 150 c.b. wall do., £1,461; 50 c.b. table do., £236; 100 automatic party line do., £283; 28 Stromberg-Carlson portable do., £90.—L. P. R. Bean.

10,836 automatic wall telephones, £42,582; 3,489 automatic table do., £20,847; 2,705 c.b. automatic table do., £11,383; 5,501 calling dials, £6,944.—Siemens Bros. & Co., Ltd. —*Tenders.*

France.—La Société la Canalisation Electrique, of St. Maurice, has lately secured a contract from the French State Railway authorities in Paris for the supply of 60 kilometres of rubber-insulated, single-conductor cable. The same authorities have also placed a contract with the Société Industrielle des Téléphones, of Paris, for the supply of 50 kilometres of single-conductor cable.

London.—Hammersmith.—The Electricity Committee has decided, in view of the probable increased demands for electricity in the near future, that an order for the second 10,000-kW set, with condensing plant, should be placed at once, particularly as delivery cannot be obtained until the summer of 1922. Messrs. A. C. Parsons & Co.'s price for the first set was £42,470, and Messrs. Hick, Hargreaves & Co., for the condenser, £14,952. Owing to increased cost of raw materials, &c., Messrs. Parsons' and Hargreaves' prices for the second 10,000-kW turbo-generator and condenser are £47,570 and £15,800 respectively. The Committee recommends acceptance of these estimates.

Copes, Feed-water regulator, £51.—Scholay & Co. (recommended).

Stepney.—Electricity Committee. The following offers of coal have been accepted:—

420 tons Northumberland nut smalls, at 46s. 6d. per ton, E. Foster & Co.
150 tons Scotch-washed trebles, 56s. 5d. ton; 150 tons do. doubles, 55s. 5d. ton; 150 tons do. singles, 54s. 5d., Bradbury, Son & Co. (1920), Ltd. 140 tons Northumberland nuts, 51s. ton, J. Hudson & Co., Ltd.
50 tons pitch, £519.—J. Smart & Son (recommended).
2 tons plumbers' solder, £170.—G. W. Neale (recommended).
¼ mile 0225 sq. in. lead-covered and armoured cable, £136.—W. T. Henley's Telegraph Works Co., Ltd. (recommended).
2 tons sheet lead, £76.—Newsome & Co., Ltd. (recommended).
700 fuse boxes, £253.—Reason Manufacturing Co., Ltd.

Stoke Newington.—Electric Lighting Committee. For mains in connection with the extension, also distributing mains, five tenders were received. The Committee recommends acceptance of the tender of Messrs. W. T. Henley's Telegraph Works Co., Ltd., of £18,668, based upon standard prices of £100 per ton for copper and £30 per ton for lead, and increasing or decreasing with the price of these metals.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, February 4th. At Caxton Hall, At 8 p.m. Lecturette, "Surface Tension and some of its Industrial Applications," by Mr. W. H. Ballantyne.

February 11th. "Notes on Some Limit Gauges," by Mr. F. A. Simpson.

Chief Technical Assistants' Association.—Saturday, February 5th. At Anderton's Hotel, Fleet Street, E.C. At 3 p.m. Paper on "Adjudication of Tenders for Turbo-alternators," by Mr. J. R. J. Bowden.

Society of Engineers.—Monday, February 7th. At Burlington House, Piccadilly, W. At 5.30 p.m. Presidential address by the Right Hon. Lord Headley, and presentation of Premiums awarded in 1920.

Dynamicabies.—Tuesday, February 8th. At the Trocadero Restaurant. At 7.30 p.m. Dinner. Sir Jas. Devonshire, K.B.E., in the chair.

Institute of Marine Engineers.—Tuesday, February 8th. At the Institute, the Minories. At 6.40 p.m. Paper on "The Internal Combustion Engine Installation," by Mr. W. Pollock.

Institute of Metals.—Tuesday, February 8th. At 39, Elmbank Crescent, Glasgow. At 8 p.m. Lecture on "Aluminium, Production and Uses," by Dr. G. H. Bailey.

Royal Society of Arts.—Tuesday, February 8th. At John Street, Adelphi, W.C. At 8 p.m. Paper on "Some Notes on the Problem of Unemployment," by Mr. E. C. de Segundo.

Association of Engineers-in-Charge.—Wednesday, February 9th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. Paper on "The Super-Diesel Internal Combustion Engine," by Capt. W. P. Durtnall.

Institute of Cost and Works Accountants.—Wednesday, February 9th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Address on "The Position of the Cost and Works Accountants in Co-ordinating the Aims of Capital and Labour," by Mr. H. W. Allingham.

Manchester Wireless Society.—Wednesday, February 9th. Paper on "Searchlights and their Work during the War," by Mr. J. C. A. Reed.

Chelmsford Engineering Society.—Thursday, February 10th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Electric Welding," by Mr. J. H. Johnson.

Efficiency Exhibition.—Olympia, W. February 10th to 26th.

Institution of Electrical Engineers.—Thursday, February 10th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Discussion on "Electric Appliances for Domestic Purposes." To be introduced by a paper by Mr. E. Griffiths and Mr. F. H. Schofield on "Some Thermal Characteristics of Electric Ovens and Hot Plates."

Liverpool Sub-Centre.—Monday, February 7th. At the University, Liverpool. At 7 p.m. Discussion of Report on Research on "The Heating of Buried Cables." To be opened by Mr. E. B. Wedmore.

Western Centre.—Monday, February 7th. At the Merchant Venturers' Technical College, Bristol. At 7 p.m. Paper on "The Application of the Electric Locomotive to Main Line Traction on Railways," by Lieut.-Col. O'Brien.

North-Midland Centre.—Tuesday, February 8th. At the Hotel Metropole, Leeds. At 7 p.m. Paper on "Temperature Limits of Large Alternators," by Mr. G. A. Juhlin.

North-Western Centre.—Tuesday, February 8th. At the Engineers' Club, Manchester. At 7 p.m. Address by the President, Mr. Lt. B. Atkinson.

Scottish Centre.—Tuesday, February 8th. At 207, Bath Street, Glasgow. At 7.30 p.m. Paper on "Automatic Protective Devices for Alternating Current Systems," by Mr. A. E. McColl.

North-Eastern Centre.—Friday, February 11th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Conversazione.

Scottish Centre (Students' Section).—Friday, February 11th. At the Royal Technical College, Glasgow. At 7.30 p.m. Paper on "Mercury Arc Rectifiers," by Mr. R. L. Morrison.

Roentgen Society.—Thursday, February 10th. At the Royal Society of Medicine, Wigmore Street, W. At 7.30 p.m. Conjoint meeting: The Institution of Electrical Engineers and the Electro-therapeutic Section of the Royal Society of Medicine.

Electro-Harmonic Society.—Friday, February 11th. At the Great Hall, Cannon Street Hotel, E.C. At 8 p.m. Concert. Ladies' night.

Institute of Industrial Administration.—Friday, February 11th. At the Central Hall, Westminster. At 8 p.m. Address on "Present Day Industrial Psychology," by Sir Lynden Macassey, K.B.E., K.C.

Faraday Society and the Manchester Literary and Philosophical Society.—Friday, February 11th. At 36, George Street, Manchester. At 6.30 p.m. Lecture on "Studies in Capillarity," by Drs. A. Ferguson and P. E. Dowson.

Manchester Association of Engineers.—Friday, February 11th. Anniversary dinner.

Physical Society of London.—Friday, February 11th. At the Imperial College of Science, South Kensington, S.W. At 5.15 p.m. Discussion on "Absolute Measurements of Electrical Resistance and Instruments based on the Temperature Variation of Resistance."

Birmingham and District Electric Club.—Saturday, February 12th. At the Grand Hotel, Colmore Row. At 7 p.m. Paper on "Reminiscences of the Test Bed," by Mr. J. A. McDonald.

NOTES.

Why Not Electricity ?—A correspondent to the *Bradford Daily Telegraph* says :—"In these days when so much progress has been made with electric power, it is surprising to find mill chimneys still being built within the city boundaries. We get occasional glimpses of what Bradford would be like without its canopy of smoke, and we are all looking forward to the time when mill chimneys will be abolished entirely, thus making Bradford as healthy as Harrogate. Perhaps it would help towards this end if there was some system of co-ordination between the city engineer's department and the electricity department by which, before plans were passed for the erection of a new mill chimney, efforts would be made to induce the mill owner to adopt electric power."

Kelvin Medal, 1920.—At a meeting of the Award Committee, consisting of the presidents of the principal representative British engineering institutions, held in London on January 25th, the first triennial award of the Kelvin Gold Medal was made to Dr. W. C. Unwin, F.R.S., who, in the opinion of the Committee, after its consideration of representations received from leading engineering bodies in all parts of the world, is the most worthy to receive this recognition of pre-eminence in the branches of engineering with which Lord Kelvin's scientific work and researches were closely identified. The arrangements for the presentation of the Medal will be announced shortly. The Kelvin Gold Medal was established in 1914 as part of a memorial to the late Lord Kelvin, and in association with the window placed in Westminster Abbey in his memory by British and American engineers.

Scottish Motor Show.—The Scottish Motor Show, which opened in the Kelvin Hall at Glasgow, on January 28th, proved one of the most popular exhibitions ever held in that city. Besides motor cars, light cars and industrial vehicles, electric lighting systems, dictaphones, electric heaters, &c., are also on view. The attention of all motorists interested in the electrical equipment of cars will be directed to the C.A.V. exhibits on Stand No. 69, which is the Scottish Show headquarters of Messrs. Thomson & Brown Bros., Ltd. New departures in C.A.V. productions are shown, including the new starting and lighting batteries with the Willard threaded rubber insulation. The latest wing lamps of "Streamline" form, adapted for focusing, are worthy of special attention, as also the "D.H." headlamps and the new "Model 10" C.A.V. horn. Light-car, touring-car, and commercial lighting sets will demonstrate the improvements in dynamo and lamp manufacture, and the combined dynamo, lighting, and coil ignition units will amply prove that this method of ignition is becoming extremely popular.

The Ministry of Transport.—It is reported that the Cabinet has decided to reduce the staff of the Ministry of Transport at an early date. The civil engineering and development branches are to be more or less scrapped, involving pay rolls, apart from war bonus, of respectively £19,300 and £10,400 per annum. The much-discussed Area Transport Commissioners are to be dispensed with *en bloc*, but the finance, statistical, roads, traffic, public safety, and general purposes departments are to be retained, although the subordinate staff is to be curtailed as much as possible. It will be remembered that the civil engineering department was responsible for the proposed Severn estuary tidal power scheme.

A Safety Celluloid.—With reference to the note in our January 21st issue concerning the Celluloid Act, 1915, and the London County Council regulations which provide that not more than 112 lb. in weight may be stored, the new product of the British Cellulose and Chemical Manufacturing Co., Ltd., called "Celastoid," is a safety celluloid which has been approved by the London County Council for use in theatres, &c., where hitherto ordinary celluloid has been prohibited. We have found the new product very difficult to ignite, and even when alight the flame extinguishes itself immediately the source of heat is removed. There is no reason at all why premises should be filled with the explosive nitro-celluloid when a British-made safety celluloid is available.

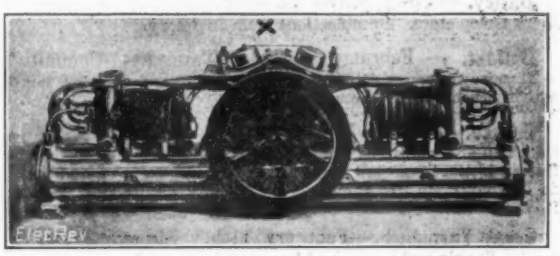
French Summer Time.—It is announced that summer time will commence in France on the night of March 14th-15th.

The E.P.E.A. Award.—On January 31st, the Wolverhampton Town Council refused to adopt the schedule arranged by the National Joint Board for payment of the technical staffs of electricity supply works. As a result, the engineers resolved to stop work at 10 o'clock on February 1st to enforce the adoption of the rates which have been accepted by practically every undertaking in the country. The Mayor counselled acceptance, pointing out that the extra £2,000 per year would not "pave the way to ruin." Local manufacturers held a meeting protesting against the short-sighted action of the Council, which would lead to the unemployment of thousands.

Eventually the Council acceded to the adoption of the schedule, and the strike was averted.

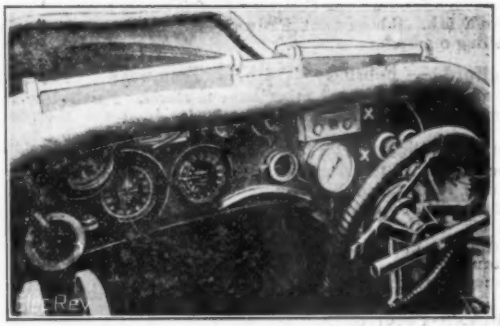
Appointments Vacant.—Mains foreman for the Corporation of Wrexham Electricity Department; electrician, for the Worcestershire Mental Hospital, Bromsgrove; resident power station engineer, for the Clyde Valley Electric Power Co.; shift engineer, for the Borough of Burton-on-Trent Electricity Department; engineering draughtsman, for the Salford Corporation Electricity Department; lecturer in electrical engineering (£536), for the Bradford Technical College. For particulars see our advertisement pages to-day.

An Automatic Aeroplane Stabiliser.—We are informed by Messrs. Handley Page, Ltd., that for some weeks past an aeroplane from the Cricklewood aerodrome has been flying long distances for the purpose of thoroughly testing a new automatic device which it is claimed will relieve the air pilot of the strain upon his nerves and sight now involved in long-distance flying, particularly when passing through heavy clouds or fogs. The device, which is marked X in the accompanying illustrations, will also greatly facilitate night-flying. At present the pilot must give his undivided attention to ensure the perfect equilibrium of his craft when in the air. The object of the new device, which is the invention of M. Georges Aveline, a French engineer and former military pilot, is to control automatically every movement of an aeroplane with the exception of steering. That is to say, it ensures



Air Compressors and Mercury Contact Makers.

perfect stability of the aeroplane, and any tendency to a list or plunge is immediately rectified by automatically moving the mechanical appliances which the pilot would have to adjust in order to level up his machine. Briefly, the device consists of the utilisation of compressed air combined with an electrical current. The air is automatically compressed by two small air pumps which are fitted beneath the forepart of the fuselage, and are actuated by small air-propellers. The air is conveyed to a reservoir connected to a pressure gauge fitted in the pilot's cockpit, so that he can see that the necessary pressure of 60 lb. to the sq. in. is maintained. Above the pressure gauge is a small electrical switchboard with a tiny lamp fitted to the right and to the left. The air is conveyed to a circular tubular container half-filled with mercury and so contrived that as the level of the fluid metal rises to the left or to the right with the movement of the aeroplane, it causes a contact to take place which permits an electric current to act on valves which



Cockpit Switchboard and Pressure Gauge.

set in motion the mechanical gear connected with the pilot's controlling mechanism. Simultaneously, the right or left-hand lamp on the switchboard lights up to indicate the variation of the equilibrium, the current being cut off and the lamp automatically extinguished as the aeroplane is brought up to the correct level. By merely raising a small lever in the cockpit, the whole of the mechanism is thrown out of gear and the pilot is free to take full control of the machine again. One of the flights referred to included a trip to Paris and back, when Major Brackley, who is responsible for the tests, allowed the aeroplane to fly for two hours consecutively under the sole control of M. Aveline's invention. The British Government has adopted the invention after exhaustive tests, and 14 Handley Page bombing machines have already been fitted with it for the Royal Air Force.

Costing and Industrial Relations.—On Wednesday, February 9th (7 p.m.), at the Institute of Chartered Patent Agents, Staple Inn Buildings Holborn, Mr. H. W. Allingham, M.I.Mech.E., will deliver an address to the Institute of Cost and Works Accountants on "The Position of Cost and Works Accountants in Co-ordinating the Aims of Capital and Labour." Readers may obtain tickets from the Secretary of the latter Institute, at 38, Grosvenor Gardens, S.W. 1.

Regan Train Control System.—The French Ministry of Public Works and representatives of the French railways intended to carry out tests on January 28th of the Regan automatic train control device, which was tried last September on the Great Eastern Railway system in this country, and was described in our pages at the time.

Freemasonry.—At the regular meeting of the Kelvin Lodge, which was held at the Mark Masons' Hall, London, on Friday last, the reigning master, Mr. H. Porter-Cox, presided over a gathering of 98 members and visitors, including three Grand Lodge officers, namely, Messrs. Charles F. Quicke, E. J. Reid, and P. P. Kipping, as well as others of Provincial and London rank, and all present enjoyed the speeches and the musical entertainment which was provided after dinner. Applications to join the Lodge are coming in steadily, and each year the support given to the great masonic charities seems to exceed that of the previous year.

An X-Ray Martyr.—The *Daily News* states that Mr. Ewart Henry Harnack has entered Southampton Hospital for the amputation of his right hand. This gentleman, who with Dr. H. P. Dean was the inventor of protective lead glass, has already lost his left hand as a result of his devotion to the science of radiography. Mr. Harnack states that when, in the early days of the science, he found that his fingers were being affected, he attributed it to the use of strong chemicals, but on ascertaining the true cause he set out to devise a means of protection for X-ray workers.

R.A.F. Dinner.—The Electrical Section, E.R.S., R.A.F., re-anion dinner was held at Pinoli's Restaurant on January 29th, the arrangements by Mr. P. B. O. S. Webb, Committee chairman, being admirably carried out. Mr. H. Mason, in a short speech, thanked the Committee for organising the gathering of a highly successful section at E.R.S. Ponte d'Larche. Mr. Webb, in reply, dwelt on the spirit of comradeship shown by the large attendance of provincial men, and stated that Mr. H. Mason will preside at the next dinner, which will be held in Birmingham. An impromptu concert followed, items being given by Messrs. Lewis, Hill, Eldridge, Sorginson, and Athill.

Electro-Harmonic Society.—The next concert (Ladies' Night) will be held at the Cannon Street Hotel, in the Great Hall, on Friday, February 11th, commencing at 8 p.m. The artistes will be:—Miss Violet Openshaw, contralto; Mr. Sydney Pointer, tenor; Mr. Edward Dykes, bass; Miss Gladys Millage, songs at the piano; Mr. Ernest Rutherford, concertina; Mr. Lloyd Shakespeare, cornet; Mr. Wilson James and Mr. Joe Pearson, humorists; Mr. Bernard Flanders, A.R.A.M., solo pianoforte and accompanist. Chairman, Capt. R. J. Wallis-Jones, O.B.E., T.D.

The Electrification of the Belgian State Railways.—Some supplementary details with regard to the electrification of the Belgian State railways were contained in the 1920 Budget report presented to the Belgian Parliament. As briefly mentioned in a recent issue, it is proposed that the work shall be undertaken in three sections. The first to be dealt with will be the Brussels-Antwerp line; the second, the Luxemburg section; and the third, the lines in the Brussels district not included in the first two sections.

The *Moniteur des Intérêts Matériels* states that with regard to the Brussels-Antwerp lines it has been recognised that it will be necessary to undertake the work in three divisions owing to the large amount of track work which will have to be carried out. It is intended to commence with the provision of electric passenger trains, which will be hauled by a combined electric locomotive and passenger coach. The train will consist of three coaches with a total of 550 seats. The coaches will be of steel or part-steel construction and mounted on bogies. The motor coach will be provided with four motors of 275 H.P. each. It is proposed to provide for 38 trains per day in each direction between Brussels and Antwerp (direct, semi-direct, and omnibus trains). On this section, the length of main track to be electrified is 54¼ miles and of secondary track, 9¼ miles.

The second division of the work on the Brussels-Antwerp section will be that of providing a more frequent service, and the third division of the work will be the electrification of further portions of the track, so that all traffic—goods as well as passenger—between Brussels and Antwerp will eventually be electrically hauled.

The Brussels-Midi junction will be electrified, and a double track between Brussels-Midi and Antwerp will be specially reserved for direct and semi-direct trains as well as for the international trains. The slow passenger and also the goods trains will use a second double track, so that by avoiding the mixing of the two classes of traffic a more frequent service will be possible. It is contemplated that eventually there will daily run between Brussels and Antwerp in each direction 54 express trains, at intervals of 20 minutes; 18 semi-direct trains starting every hour, and 22 omnibus, or as we term them, Parliamentary trains. The express trains are expected to do the journey between Brussels Nord and Antwerp Central in 32 minutes, equal to an average speed of 83 km., or nearly 52 miles per hour, the maximum speed attained being 56 m.p.h. The times for semi-direct trains will be reduced from 54 to 37 minutes, and those of the omnibus trains from 72 to 56 minutes.

For the haulage of the international trains it is proposed to use an electric locomotive of 2,200 H.P., while for the haulage of goods trains electric locomotives capable of hauling trains of a total load of 1,000 tons at a speed of 28 m.p.h. are contemplated.

In the third division of the work the electrification of the double track between Malines and Antwerp South will be undertaken, as well as the train-forming yards at Schaerbeek, Muysen, Zurenborg, Austruweel, Kiel, and Antwerp South, although the actual shunting will continue to be carried out by steam locomotives.

For the supply of the necessary energy three large sub-stations will be established at Schaerbeek, Malines, and Berchem, the latter place being near Antwerp. The annual consumption of energy on the Brussels-Antwerp section is estimated at 100,000,000 kilowatt-hours, equal to 30 watt-hours per ton-kilometre.

The second section of the electrification work is that of the Luxemburg and neighbouring lines. For the ordinary service motor-trains similar to those on the Brussels-Antwerp line will be employed, while the international and goods trains will be hauled by electric locomotives, average and maximum speeds of 44 and 56 m.p.h. being provided for. Owing to the heavy gradients on these lines it will be necessary to use two electric locomotives for each goods train, which will, however, attain an average speed of 25 m.p.h. as against 20 m.p.h. by steam. For this division it is estimated that 400,000,000 kilowatt-hours per annum will be necessary.

The final section of the work to be undertaken will be the electrification of the whole of the lines in the Brussels district, which will obviate the present delays due to the necessity of changing from electric to steam traction and *vice versa* which at present obtains.

INSTITUTION NOTES.

Institution of Electrical Engineers.—The arrangements for the second part of the 1920-21 session are as follows: February 10th, discussion on "Electric Appliances for Domestic Purposes," to be introduced by a paper on "Some Thermal Characteristics of Electric Ovens and Hot Plates." Prof. E. Wilson on "Feebly Magnetic Materials," February 17th, Lecture I "Instrumentation"; February 24th, Lecture II "Results of Scientific Research"; March 10th, Lecture III "Practical Applications"; March 3rd, annual dinner at Hotel Cecil. March 17th, paper by Sir W. Noble on "The Long-distance Telephone System of the United Kingdom." April 7th, subject to be announced later. April 14th, paper by Mr. E. A. Watson on "Magnetos for Ignition Purposes in I.C. Engines." April 28th, discussion on "Tariffs"; papers by Mr. J. R. Blaikie—"Electricity Supply: Present Conditions and the Hopkinson Principle," and J. W. Beauchamp, "Multi-part Tariffs for Domestic Electricity Supply." May 5th, continuation of discussion on "Tariffs."

Informal Meetings.—Febuary 14th, discussion on "Some Notes on the Design of a Large Power Station," opened by Mr. J. W. Cowie. February 28th, informal social evening. March 14th, discussion on "Rectifiers," opened by Mr. R. L. Morrison. April 11th, discussion on "Some Characteristics and Applications of Multi-speed a.c. Motors," opened by Mr. F. Creedy. April 25th, discussion on "Engineering in Russia," opened by Mr. C. L. Lipman.

North-Eastern Centre.—February 11th, conversazione. February 14th, "Temperature Limits of Large Alternators," by Mr. G. A. Juhlin. February 28th, lecture on "Thermionic Valves," by Mr. W. D. Owen. May 9th, annual general meeting.

North Midland Centre.—February 8th, "Temperature Limits of Large Alternators," by Mr. G. A. Juhlin. April 26th, annual general meeting.

North-Western Centre.—February 8th, address by the President. February 22nd, "Magnetos for Ignition Purposes in I.C. Engines," by Mr. E. A. Watson. March 8th, "Electric Driving in the Paper Mill on Heat-economy Lines," by Mr. A. B. Mallinson. April 12th, annual general meeting and smoking concert.

Scottish Centre.—February 8th (Glasgow), "Automatic Protective Devices for a.c. Systems," by Mr. A. E. McColl. March 8th (Edinburgh), "The Long-distance Telephone System of the United Kingdom," by Sir W. Noble. April 12th (Glasgow), lecture on "Wireless," by Dr. J. Erskine-Murray.

South Midland Centre.—February 23rd, discussion on "Electric Appliances for Domestic Purposes," to be introduced by a paper by Mr. E. Griffiths, D.Sc., and Mr. F. H. Schofield, B.A., B.Sc., on "Some Thermal Characteristics of Electric Ovens and Hot Plates." April 27th, paper by Mr. E. A. Watson on "Magnetos for Ignition Purposes in I.C. Engines," and annual general meeting.

Western Centre.—February 7th (Bristol), "The Application of Electric Locomotives to Main Line Traction on Railways," by Lt.-Col. H. E. O'Brien, D.S.O. May 2nd (Bristol), address by the President.

Membership.—At the ordinary meeting on Thursday last week the balloting list for the election of new members and for the transfers from one class to another contained a total of 616 names, of which 556 are the names of new members. This constitutes a record, and raises the membership figure to the 9,000 mark. The new members of the various classes were divided as follows: Members, 4; associate members, 116; graduates, 42; students, 333; and associates, 3. The figures in the last list were respectively 6, 52, 30, and 181, or a total of 269.

Students' Section.—An interesting address on "Magnetos" was given before the Students' Section of the North-Eastern Centre on January 21st, by Mr. W. Bayliss, who detailed the various parts of the magneto and explained their functions.

Chelmsford Engineering Society.—On January 26th, Mr. C. S. Buyers read a paper on "Electric Winding for Collieries." The lecturer divided his paper under the following heads: (1) Nature of work and general requirements to be fulfilled. (2) Types of winding drum and their effect on the power demand, and (3) Systems of electric drive and their applications.

Edinburgh Electrical Society.—On January 28th, Mr. E. C. Catford, of the Edinburgh Corporation Tramways, delivered a lantern lecture on "The Electrical Wonders of Guernsey." The lighting and tramway system of the island and the very admirable telephone system were described. On February 11th the Society will meet at the North British Rubber Works.

Physical Society of London.—On February 11th, at the Imperial College of Science, South Kensington, there will be a discussion on "Absolute Measurements of Electrical Resistance, and Instruments based on the Temperature variation of Resistance." The speakers will include Sir Richard Glazebrook, F.R.S., Mr. F. E. Smith, O.B.E., F.R.S., Prof. H. L. Callender, F.R.S., Prof. C. R. Darling, Mr. C. Jakeman, Major W. S. Tucker, Capt. E. J. Paris, Prof. J. T. McGregor Morris, Dr. J. S. G. Thomas, Mr. A. H. Davis, Dr. G. A. Shakespear, Prof. Leonard Hill, Mr. E. A. Griffiths, Dr. Daynes, and Dr. Ezer Griffiths.

Institute of Physics.—The recently incorporated Institute of Physics has issued a booklet setting forth the objects of the Institute and regulations for the admission of members, students, associates and fellows. Full details of the necessary qualifications, examinations and exempting degrees, &c., are given.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review posted as to their movements.

The *Financial Times* says that the following appointments have been agreed by the directors of the Underground group of companies, which includes the Underground Electric Railways Co. of London, Metropolitan District, London Electric, City and South London, and Central London Railways, and London General Omnibus Co.: Assistant managing directors, Mr. H. E. Blain and Mr. F. Pick; director for construction (railways), Mr. Z. E. Knapp; chief engineer (omnibuses), Mr. G. J. Shave; chief engineer (railways), Mr. A. R. Cooper; secretary and treasurer, Mr. J. C. Mitchell. At the same time, the management of the London and suburban traction group, namely, the Metropolitan Electric, London United, and South Metropolitan Electric Tramways, has been brought into direct connection with the Underground management, and the following appointments have been agreed upon: Mr. C. J. Spencer, general manager; Mr. E. Boys, secretary and treasurer.

Mr. E. J. Nally, president of the Radio Corporation of America, arrived in England on January 30th, and is staying at the Ritz Hotel, London. He has come over to attend a conference between representatives of wireless telegraphic interests in England, France, and Germany to discuss the commercial development of wireless telegraphy.—*Daily Mail.*

After 26 years of continuous service, Mr. Percy R. Allen, O.B.E., has retired from the active engineering management of the Castner-Kellner Co.; he is being retained by the firm in a consultative capacity. At a dinner given to Mr. Allen by the staff of the company, at which the managing director presided, the presentation of a gold cigarette box, suitably inscribed, was made. Later Mr. Allen was the recipient of a silver tea service from the staff and employés. Mr. Allen will continue to practise as a consulting engineer for steam and gas plant work and the electrification of mines.

The question of increasing the salary of Mr. P. P. Wheelwright, the electrical engineer to the Blackburn Corporation, is under consideration by the Electricity Committee, which is obtaining information as to salaries in other towns. The present salary is £1,000 a year.

Mr. W. Morries, B.Sc., who has been the chief electrician at the Blackley works of the British Dyestuffs Corporation for the past three years, is resigning that position in order to enter business as an electrical engineer and wiring contractor, at 35, Cheapside, Middleton, Manchester. On January 27th the electrical staff presented him with a rose bowl. The presentation was made by the chief engineer of the works engineering department (Mr. C. E. S. Place). Mr. W. Morries, in responding, asked the staff to co-operate closely with his successor, Mr. J. H. Davies. Mr. W. Morries wishes to receive price lists and catalogues from makers of electrical equipment for both power and lighting.

Mr. A. J. Giffin left the Western Electric Co., Ltd., at the end of January to take up an appointment with the Bradford Dyers' Association, Ltd.

Mr. H. C. Waters has been appointed managing director of A.G.E. Electric Motors, Ltd., of Stowmarket, having served the company previously as technical director.

Obituary.—Mr. S. T. Smith.—The death occurred on January 26th of Mr. S. Trow Smith, gas and electrical engineer to the Malvern Urban Council.

Sir Ralph Percy Ashton.—The death occurred on Friday last, at his home at Beechwood, Reigate, of Sir R. P. Ashton, who was a director of the Indian Electric Supply & Traction Co., Ltd., the Enfield Ediswan Cable Works, and other companies, and a partner in the firm of Kilburn, Brown & Co. Sir Ralph, who was 60 years of age, had not enjoyed good health of late, and business matters depressed him. The verdict was "Suicide while of unsound mind."

NEW COMPANIES REGISTERED.

Electrical Apparatus Export Corporation.—Particulars of the Electrical Apparatus Export Corporation have been filed pursuant to Section 274 of the Companies (Consolidation) Act. The company was incorporated in Delaware, U.S.A., on December 24th, 1919. The capital stock is $50,000 in shares of $100 each. The British address is at 408-9, Bank Chambers, High Holborn, W.C., where J. A. Campbell is authorised to accept service of process and notices on behalf of the company. The list of directors is not yet filed.

Practical Machines Co. (A. T. Gadsby), Ltd. (172,826).—Private company. Registered January 27th. Capital, £10,000 in £1 shares (1,000 preference). To adopt an agreement with A. T. Gadsby, and to carry on the business of electrical and general engineers, manufacturers of and dealers in electrical and other machinery, founders, metal spinners and merchants, &c. The first directors are: A. T. Gadsby, 119, Wells Street, Camberwell, S.E. (permanent director, chairman and sole managing director); H. Berry, 10, Greenholm Road, Eltham, S.E., engineer. Qualification, £100. Registered office: 39, Avenue Chambers, 4, Vernon Place, Bloomsbury, W.C.

Duttons (Southport), Ltd. (172,755).—Private company. Registered January 24th. Capital, £3,000 in £1 shares. To take over the business of electrical engineers and accumulator manufacturers, carried on by H. Dutton and A. Dutton as "H. and A. Dutton," at Southport. The permanent directors are: H. Dutton, Ansdell Road North, Lytham: A. Dutton, Marlborough Road, Southport. Registered office: 1a, Marlborough Road, Southport.

Graham & Sons, Ltd. (172,842).—Private company. Registered January 28th. Capital, £5,000 in £1 shares. To carry on the business of electrical engineers, manufacturers of electrical machinery, instruments, cable, glass and porcelain ware, insulation materials, mechanical, marine, constructional, internal combustion and general engineers, &c. The first directors are: J. P. Graham (permanent), Hillcroft, Stocksfield; C. P. Graham, Hillcroft, Stocksfield; S. E. Graham, Hillcroft, Stocksfield. Qualification, 100 ordinary shares. Secretary: Jessie Bryce. Registered office: Sun Insurance Buildings, Collingwood Street, Newcastle-on-Tyne.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ignitions, Ltd.—Particulars of £5,000 debentures authorised December 3rd, 1920; present issue £1,400; charged on the company's undertaking and property, present and future, including uncalled capital.

Sphinx Manufacturing Co., Ltd.—Mortgage dated January 4th, 1921, to secure all moneys due or to become due from company to London Joint City and Midland Bank, Ltd., charged on 243, Bradford Street, and 187-199, Alcester Street, Birmingham.

Lithanode Co., Ltd.—Particulars of £3,000 debentures authorised December 31st, 1920; present issue £1,000 charged on the company's undertaking and property, present and future, including uncalled capital.

C. A. Vandervell & Co., Ltd.—Debenture dated December 31st, 1920, to secure £200,000 charged on the company's undertaking and property, present and future, including uncalled capital, and freehold and leasehold property. Holders: D. J. H. Cunnick, Sir Frederick Eley, Bt., and A. G. Hopewell, 15, Bishopsgate, E.C.

Leonard W. Holmes and Partners, Ltd.—Debenture dated January 19th, 1921, to secure £3,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holder: S. P. Powell, 53, Wynstay Gardens, Kensington, W. 8.

Norwegian Electric Smelting Co., Ltd.—Particulars of £10,000 debentures authorised December 30th, 1920, whole amount issued, charged on company's undertaking and property, including uncalled capital and goodwill.

CITY NOTES.

Melbourne Electric Supply Co., Ltd.

Delays in the mails delayed the completion of the accounts for the year ended August, 1920, but the final dividend, making the total 10 per cent., free of British income tax, was approved at a meeting in December, and the borrowing powers were increased from £750,000 to £1,000,000. The accounts are now published, and they show a gross profit on the Melbourne and Geelong undertakings of £221,388 (against £180,161 for the previous year, an increase of 23 per cent., which, in view of the conditions, is satisfactory). After providing for management and general expenses, debenture and other interest and services, £10,149

is written off capital expenditure, £30,000 is put to reserve for British income tax, Corporation tax, and E.P.D., £10,000 to Gold Bonds Redemption account, and £35,000 to general reserve. After paying the 7 per cent. dividend on the first cumulative preference shares, 10 per cent., free of British tax, on the consolidated ordinary stock on the ordinary shares, £4,691 is the remaining balance, plus £50,051 brought forward, making the total to be carried forward £54,742. In order to facilitate the provision of further capital necessary to cope with the continued expansion of the business, resolutions will be submitted at a meeting on February 7th for the purpose of increasing the rate of dividend on the whole of the authorised issue of 100,000 first cumulative preference shares of £5 from 7 per cent. per annum to 8 per cent. per annum as from March 1st, 1921. In consideration of this increase the holders of the 70,000 preference shares already issued will be asked to consent to the premium of 10 per cent. to which they are entitled upon repayment of capital on the winding up of the company being reduced to 5 per cent. The development figures are as follows:—

Melbourne.	Consumers.	Lighting in kW.	Motors in rated h.p.	Total connections, kW.	Total units sold.
Year ended Aug., 1919 ...	42,430	36,189	30,318	66,507	35,069,000
" " " 1920 ...	51,675	44,006	34,478	78,485	44,444,000
Geelong.					
Year ended Aug., 1919 ...	3,374	3,082	2,415	5,497	1,551,042
" " " 1920 ...	3,862	3,384	2,509	5,894	1,627,276

Light and power was made available in 62 additional miles of streets at Melbourne during the year, and 9,245 new consumers were connected (increase 22 per cent.); power supply increased by 14 per cent.; total connections by 18 per cent.; total units sold by 26 per cent.; and gross revenue by 24 per cent. Notwithstanding the heavy increase in the cost of labour, fuel, and materials generally, an increase in charges to consumers has been avoided.

Yorkshire Electric Power Co.

During the year ended December, 1920, there was a substantial increase of revenue and profit. The net profit, after payment of interest, was £64,740, against £54,133 for 1919, and £46,536 for 1918. Including £17,596 brought forward, the amount is £82,336. Preference dividend 6 per cent.; dividend on the ordinary at the rate of 5 per cent. for the six months, making a total of 8 per cent. for the year; to general reserve (making it £89,000), £15,000; carrying forward £20,939. The works have been fully maintained out of revenue. During the year the costs of coal, wages and materials showed further increases, which were met to some extent by the economies arising from the increased output. The extensions of the company's power stations which are now proceeding, and which include a 12,000-kW turbo-alternator, should produce still further economies when they come into use in the present year. A large number of new connections have been made, the full revenue from which will not be secured until the present year. Further agreements for supply have been made which will also produce a substantial increase of revenue. The unification of the supply of electricity in the West Riding which has been made possible by the existence of the company's system, continues to grow. Out of a total of 62 undertakings of authorised distributors in the company's area, 40 are taking or have agreed to take a supply of electricity in bulk from the company and negotiations are proceeding with others which should lead to a complete co-ordination of the supply of electricity in the company's area. The Electricity Commissioners appointed by the Electricity (Supply) Act, 1919, have given notice of their intention to hold inquiries into the present and future position of electricity supply in certain districts, which together include the company's area of supply, and it is hoped that the Commissioners' action may lead to the removal of the legislative obstacles which have retarded the development of the company's undertaking. The issue in February last of £230,000 of 5½ per cent. redeemable debenture stock and £400,000 of ordinary shares was utilised for the purpose of repaying existing mortgages and loans and to provide capital to meet growing demands for power. The company has power to borrow by the issue of debenture stock to the extent of one third of the issued share capital, and in view of the further demands for power already in sight, a resolution authorising the issue, from time to time, of further debenture stock within the scope of this authority will be submitted at the close of the annual meeting on February 15th. The company has recently purchased premises in Leeds to be used as head offices. Mr. Hardman Arthur Earle, who has been a director of the company since its formation, has resigned through ill-health.

The Siemens and Schuckert Group.

The *Siemens & Halske Co.*, of Berlin, reports gross profits and balance forward amounting to 26,844,000 marks for 1919-20, as compared with 15,736,000 marks in the previous year. After defraying general expenses and interest on loans, and transferring 4,000,000 marks to the benevolent fund jointly created with the Siemens-Schuckert Works, the accounts show net profits of 16,435,000 marks, as contrasted with 11,457,000 marks in 1918-19. It is proposed to pay a dividend at the rate of 12 per cent. on the old shares for 63,000,000 marks, as in 1918-19, and one at the rate of 6 per cent. on the new shares for 63,000,000 marks. As the financial year has now been transferred to September 30th so as to harmonise with the other companies forming the recently constituted community of interests, accounts are also submitted for August and September, 1920, showing net profits of 4,829,000 marks, and a dividend at the rate of 2 per cent. is proposed on the total capital of 126,000,000 marks. The report of the directors states that the scarcity of coal and other raw materials caused great difficulties, which were to some extent overcome by the end of the financial year. The uncertainty in calculating reliable sale prices specially influenced export business. Nevertheless it was possible profitably to increase the export of electro-technical manufactures partly in consequence of the scarcity of goods in the world's markets down to the close of the financial year, and partly owing to the quality of the manufactures and the confidence shown in the technical efficiency of the industry. Dealing with the labour problem, the report mentions that further large interruptions in working had not taken place since the Berlin strike of metal workers in November, 1919. The efficiency of the workmen had satisfactorily increased, particularly in the case of piece work; the number of workmen was about the same, although the ratio of productive wages to unproductive wages became more favourable, and the number of officials had grown. The company was interested in the Osram Co. to the extent of 40 per cent., and the first year's results of the latter already showed that the aims of the association were being achieved both technically and economically. It is stated in conclusion that the works are abundantly supplied with materials and orders.

The accounts of the *Siemens-Schuckert Werke*, including the balance forward, indicate gross profits of 37,287,000 marks for the year ended on July 31st, 1920, as contrasted with 27,650,000 marks in the previous year. After meeting general expenses, interest on loans and depreciation, and allocating 8,000,000 marks to the benevolent foundation jointly maintained with the Siemens & Halske Co., the net profits are returned at 12,769,000 marks, as compared with 15,283,000 marks in 1918-19. It is intended to pay a dividend at the rate of 10 per cent., as in 1918-19, and place 2,500,000 marks to the reserve fund, as in the preceding year. The net profits in the intermediate year from August 1st to September 30th, 1920, amount to 2,806,000 marks, permitting of the payment of 10 per cent. *pro rata* for this period. Dealing with the past year, the report of the directors states that at the beginning it was impossible for the production to meet the requirements of the market. The scarcity of manufactures and the increases in prices due to depreciating currency produced a speculative impetus in the demand. Orders came to hand far in excess of the actual absorbing capacity of the market, and led to a great accumulation of stocks in connection with the sudden change in the economic conditions at the close of the financial year. As a consequence, some circles of customers got into great financial difficulties, and the company had to extend a helping hand in order to overcome them. The economic crisis which threatened to develop from this sudden change was only avoided by a systematic co-operation of the entire electrical industry.

The financial statement of the *Elektrizitats A.G. vorm. Schuckert & Co.*, of Nuremberg, shows gross profits of 13,612,000 marks for the year ended on July 31st, 1920, as compared with 9,640,000 marks in the preceding year, the net profits being 7,228,000 marks and 6,370,000 marks in the two years respectively. During August and September, 1920, the net profits amounted to 1,848,000 marks. The directors recommend the payment of a dividend at the rate of 9 per cent. for the complete financial year, and at the rate of 10 per cent. for the two months forming the new year and resulting from the transfer of the date of the financial year.

The report, dealing with the company's investments in 1919-20, states that it was possible to accommodate the prices for the supply of energy to the conditions of the times so that the supply works were able to maintain their economic situation. This was, however, not the case to the same extent with the tramways and light railways, and many lines became so unsatisfactory that they had to suspend working partly or altogether. The creation of new supply works, and the extension of existing works were greatly prejudiced by the high degree of saturation already reached through the present uneconomically high costs of erection, as well as through the efforts in the direction of socialisation and municipalisation. On the other hand, profitable activity in other countries was still obstructed by the existing well-known conditions. Under these circumstances the company continued to devote attention to the working up of other branches of work. The report further states that a favourable influence was expected to result from the community of interests established with the Rhine-Elbe-Union.

Sunderland District Electric Tramways, Ltd.—The report for the year ended October 31st, 1920, states that after charging the expenses of operation and administration for the year and providing for depreciation of rolling stock, &c., the balance is £16,187, plus £1,209 brought forward. After providing for interest on bonds and debentures and sinking fund, also £1,800 for reduction of investments, 5 per cent., less tax, is paid on the first and second income bonds, and 5 per cent., less tax, on the preference shares, leaving £1,542 to be carried forward. Traffic receipts increased by £7,821, but the expenses increased in greater proportion, so that the decrease in operating profit was £4,427.

City of Buenos Aires Tramways Co. (1904), Ltd.—For the year ended December, 1920, a balance dividend of 1s. 3d. per share (making 5 per cent. per annum), less income tax; £3,000 to general amortisation fund, and £3,941 carried forward.

Westminster Electric Supply Corporation, Ltd.—Final dividend at the rate of 12 per cent. per annum, less tax, making 10 per cent. for the year.

Stock Exchange Notice.—The following have been ordered to be officially quoted:—

Indian Electric Supply and Traction Co., Ltd.—120,000 7 per cent. non-cumulative (convertible) preference shares of £1 each, fully paid (Nos. 1 to 120,000).

Dublin United Tramways Co. (1896), Ltd.—Final dividend at the rate of 7 per cent. per annum, less tax, making 5¼ per cent. for the year; £30,000 to deferred renewal of rails; £2,000 written off investments; £13,331 carried forward.

Provincial Tramways Co.—Net revenue for the year ended September, 1920, £40,016, plus £10,804 brought forward. To reserve and depreciation account £10,000; dividend of 10d. on the ordinary shares, making 1s. 6d. for the year (7½ per cent.). £3,008 carried forward.

St. James's & Pall Mall Electric Light Co., Ltd.—Dividend of 8s. 6d. per share on the ordinary shares, making a total of 12 per cent. for the year 1920.

Greenwood & Batley, Ltd.—An interim dividend of 2½ per cent. on the ordinary shares is announced.

Tucuman Tramways, Light & Power Co.—Loss of £8,383 for the year ended June, 1920. Debit balance £69,524.

STOCKS AND SHARES.

Tuesday Evening.

Main discussion in this week's Stock Exchange markets has focused on two points: one the reparations question and the other the Bank Rate. While it was not generally expected that the latter would be lowered on Thursday, there were some hopeful folk who looked for this step to be taken at once, and in most quarters it is generally assumed that February will certainly see the rate down to 6 per cent. The principal satisfaction felt with the decision arrived at with regard to reparations is concerned with the cordial relations re-established with France, inasmuch as, a week ago, fears were raised that friction might ensue from differences of opinion arising over the negotiations. The investment markets strengthened after their somewhat sharp reaction, and this had its effect upon the best-class issues throughout the Stock Exchange. The flatness in railway stocks passed over the Underground group, although prices here are dull rather than depressed.

The Westminster Electric Company has declared its final dividend, making 10 per cent. for the year, the same as that for 1919. It was expected that the company would repeat its previous performance, and the declaration had the effect of raising the price ¼ to 5¼. Charing Cross rose sharply to 4. Other shares in the electricity supply list are quiet, as they are bound to be in any case on the eve of dividends, the issue of which is a trifle uncertain. Newcastle Electric preference stiffened to 13s. 9d. Melbourne Electric preference improved to 4⅛ on the raising of the dividend. The new issue is expected to make its appearance some time this month. Auckland debenture advanced to 90, and in the foreign market, Anglo-Argentine Tramways 4 per cent. debenture stock at 59¼ is a point better. Rio Tramways Firsts at 89¼ and Sao Paulo Firsts at 88¼ are both higher.

The firmest market in the Stock Exchange apart from the purely gilt-edged stocks is that for cable shares. Eastern Telegraph ordinary has risen to 157½. Globes, Westerns and Eastern Extensions are nominally 15⅞ middle, but actually are rather better than they appear, inasmuch as the seller can get on at the middle price better than the buyer. The chance of taxation being increased when the next Budget is produced serves to underline the interest taken in these stocks and shares upon which dividends are paid free of tax. The yields now come to about 6¼ per cent. on the money, equivalent to 9 per cent., allowing for tax at 6s. in the £. The Henley issue was, of course, a success, and dealings started in the new shares 14s. paid on the basis of 6d. premium. To anyone who is on the lookout for a good industrial investment with reasonable chances of appreciation in future, Henley's will make an appeal as deserving a place amongst shares of this class. The old shares are 1/16 down at 28s. 9d. Anglo-American Telegraph deferred has risen again, this time to 15¼, and the preferred stock added another point to its price. Chili Telephones are up to 5¼, and United River Plates to 6¼; but Monte Video Telephones drooped to 1¼. Great Northerns have hardened to 22, a gain of 10s., and the only really weak spot in the market is that for West India and Panama shares, which have gone back to 11s. 3d. Marconis are lower at 1 15/16, the market having no friends at all at the present time. Indeed, since the dividend disappointment of six weeks ago, Marconis have been out of popular favour, although holders await with keen interest the final dividend for the year. Radio Common at 8s. 6d. and the preferred at 11s. 6d. are inactive.

British Aluminium improved to 18s. 3d., and General Electric preference at 18s. 6d. are also a few pence harder. Cromptons remain weak at 13s. 9d. There is not much doing in manufacturing shares, owing to the various industrial and financial difficulties that prevail. The public are fighting rather shy of such shares at the present time. Various speculations and rumours are already rife in respect of the next Budget, and as none of them carry consolation to the taxpayer, he is likely to play for safety in his Stock Exchange transactions until, at any rate, money becomes cheaper.

The three non-assented ordinary stocks of the Central London Railway are now quoted again, after a considerable interval, at the common price of 27½. The assented stocks remain between 43 and 47. East Londons have not moved; the meeting produced a vigorous protest from the Chairman at the way in which the company is circumscribed by Government control. Metropolitan Consolidated relapsed to 22 after being a point more, and Districts have fallen back to 15½. The Underground Electric issues are easier.

British Columbia Electric Railway stocks are now ex dividend, and the yield on the deferred comes to 12 per cent. on the basis of the last distribution. Mexicans are lower again.

The rubber share market gives no sign of animation, so prices are naturally disposed to sag. Armaments are dull, with Vickers down to 15s. Babcock & Wilcox have receded to 2⅛. The engineering group, with shares of iron, soal and steel companies generally, are slipping back by degrees, the daily declines being as small as they are persistent.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Feb. 1, 1921.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	5⅞	-	£10 4 4
Charing Cross Ordinary	4	7	4	+ ¼	8 15 0
do. do. do. 4½ Pref.	4½	4½	2⅝	—	8 5 8
Chelsea	3	4	3½	—	6 5 0
City of London	8	10	1 3/16	+ 3/32	8 8 5
do. do. 6 per cent. Pref.	6	6	17/8	—	6 17 2
County of London	7	8	7⅛	—	10 15 4
do. do. 6 per cent. Pref.	6	6	7⅞	— ¼	7 15 0
Kensington Ordinary	6	7	8½	—	9 0 6
London Electric	Nil	2½	5	—	10 0 0
do. do. 6 per cent. Pref.	6	6	9⅞	—	10 18 2
Metropolitan	5	6	2⅞	— ¼	10 18 2
do. 4½ per cent. Pref.	4½	4½	2 1/16	—	8 15 8
St. James' and Pall Mall	10	12	6½	—	9 12 0
South London	5	6	3½	—	9 12 0
South Metropolitan Pref.	7	7	13/9	—	10 3 8
Westminster Ordinary	8	10	5¼	+ ¼	9 10 6
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	79½	+1	17 11 0
do. Def.	88/6	1½	16½	+ ½	9 8 6
Chile Telephone	8	6	5½	+ ½	*5 4 4
Cuba Sub. Ord.	7	7	6½	—	*10 15 4
Eastern Extension	8	10	15½	+ ½	*8 7 0
Eastern Tel. Ord.	8	10	15 7/8	+⅛	*8 7 0
Globe Tel. and T. Ord.	8	10	15½	+ ½	*8 7 0
do. do. Pref.	6	6	8½	—	6 17 2
Great Northern Tel.	22	22	22	+ ½	10 0 0
Indo-European	13	10	80	—	8 6 8
Marconi	25	25	1 15/16	— ⅛	—
Oriental Telephone Ord.	10	12	3 1/16	—	*5 4 0
United R. Plate Tel.	8	8	6¼	+ ¼	*8 8 0
West India and Panama	1/8	Nil	11/16	— ⅛	Nil
Western Telegraph	8	10	15⅞	+ ⅛	*8 6 0
Home Rails.					
Central London Ord. Assented	4	4	43½	—	9 4 8
Metropolitan	1	1½	12	—	6 16 4
do. District	Nil	Nil	15½	—1	Nil
Underground Electric Ordinary	Nil	Nil	1¼	— ¼	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	5	4	65½	—1	—
Foreign Trams, &c.					
Anglo-Arg. Trams, First Pref.	Nil	5½	2⅞ xd	—	10 0 0
do. do. 2nd Pref.	Nil	Nil	8½	—	Nil
do. do. 5% Deb.	5	5	55½	+1	8 18 10
Brazil Tractions	Nil	Nil	38½	—	Nil
British Columbia Elec. Rly. Pfce.	5	5	55	—	9 1 10
do. do. Preferred	9½	5	60½xd	—	*8 16 0
do. do. Deferred	Nil	3	51½xd	— ½	*12 2 8
do. do. Deb.	4½	4½	64¼	—	7 16 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	40½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	35½	—1	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	21¼	—	Nil
do. 1st Bonds	Nil	Nil	69½	—2	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	15	2⅛	— ¼	*7 1 9
British Aluminium Ord.	10	10	18/3	+9d.	10 19 3
British Insulated Ord.	12½	15	15	—	9 3 10
Callenders	25	15	11	—	10 18 2
,, 6% Pref.	6½	6½	17/6	—	7 6 7
Castner-Kellner	20	17	2⅞	—	7 12 9
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	13/6	—	—
do. do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	⅝	—	11 8 8
Gen. Elec. Pref.	6½	6½	18/6	+6d.	7 2 5
do. Ord.	10	10	1½	—	*8 4 8
Henley	25	15	1 1/16	— 1/16	10 5 0
do. 4½ Pref.	4½	4½	3½	—	6 18 0
India-Rubber	10	10	¼	—	—
Met.-Vickers Pref.	—	8	1½	—	5 15 4
Siemens Ord.	10	10	1⅞	—	*9 8 9
Telegraph Con.	20	20	21½	—	*5 11 5

* Dividends paid free of Income Tax.

ON STATUTORY EARTHING: SOME CRITICISMS.

By S. LEES.

(*Concluded from page* 101.)

The primary function of the enamel protective coating on metal conduit is to shield the metal beneath from any outside disturbing influences which would produce a deteriorating effect on the metal externally as well as inside the bore. An excellent provision surely, but is it not somewhat inconsistent to deliberately and intentionally mutilate splendidly sound enamelled conduit by flaying its healthy skin, and thereby the more quickly encompassing its premature decay by providing weak spots in its system extremely liable to attack from the many outside disturbing influences? Doubtless it will be maintained that a man knowing his job will take care that conduit enamel is not intentionally damaged by providing a sufficient length of threaded surface at a convenient point, say, next to a fitting, the earth device being clasped to the additional screwed surface of the tubing. This method obviously makes a bad joint and, moreover, has other objections; it is well known that a screwed joint should always abut right up to the termination of the thread, and no bared metal should be left exposed. It is distinctly wrong and inimical to its best interests to destroy the enamelled surface of conduit and a little consideration will show that it is neither necessary nor desirable. Formerly the usual method of attaching an earth conductor to steel conduit (before drawing-in) was to wrap tightly a sufficient number of turns of copper wire round the tubing, previously tinning the wire and surface of tube, and finally soldering the wrapped joint. A sound joint of this kind would be passable, and if finished with a coating of enamel would, indeed, leave little room for criticism. But to paint over some of the abortive arrangements passing as earth devices to-day would be simply covering up still more sins. The writer is reminded of an amusing incident that occurred some twenty odd years ago. An earth connection of the sweated kind just described was being made to a biggish water main, and although the jointer had been playing on the joint for over an hour, he "couldn't get the solder to stick." And no wonder either, for, as was discovered *afterwards*—"the water was on"! It must be allowed, however, that such methods of making earth connections would be considered rather elaborate and too expensive in these competitive days. Still, if it were practicable and commercially possible to render the earthed system an integral and not readily separable part of the conduit or other system, it would be an ideal consummation. The writer, for one, believes that this laudable object can be achieved with the utmost regard to efficiency, and without prejudice to due economy. Following somewhat on the lines of old-time soldering, autogenous welding can be applied with success, and it is at least surprising that this method has not as yet made any advance beyond the experimental stage. Even supposing that welding offered insurmountable difficulties in its practical applications, another method is available in which the metal conduit system carries its own earthing connection integral with the whole, of unquestionable and unalterable 100 per cent. conductivity. With this method the usual ordinary fittings, slightly modified, are employed, which fulfil the dual function of fitting proper, and earthing connection. Hence, it seems strange and surprising that ancient and inefficient methods continue in use to-day which do not attain the object prescribed in the Regulations.

Ironclad (so-called) switch and fuse fittings, particularly of the unit type, are often indifferently adapted for earthing, any handy point being used to attach the earth wire, without due consideration of the suitability or otherwise of the frame or case of the fitting. It is obviously not sufficient to drill and tap the case and fit any odd size of screw at any casual point; the connection should be integral with the frame, sound electrically as well as mechanically, and all moving parts, *i.e.*, doors, covers, &c., should be efficiently bonded to the stationary portion of the apparatus. The writer has yet to come across a commercial example of the type of gear referred to which complies with the Regulations in this respect. Again, it is not sufficient to build up switch-fuse gear on the (so-called) unit system depending upon the natural contact between the metal framework and the fittings. Light rolled sectional iron bar as generally used for this purpose should always be faced at all points of attachment with earth conductors and switch and fuse fittings, the latter, of course, being treated likewise. The all too common practice of twisting the earth wire around the head of an ordinary wood screw, which also serves to hold the fitting in position, should be condemned. In quite a number of makes the fittings are provided with "earth screws" of absurdly small proportions and of B.A. type, placed in altogether inaccessible positions and, therefore, useless. The Home Office Rules are wise ones in this respect, and do not overestimate the importance of a good earth connection.

It is becoming quite common to find no regard given to the conductance of the earth conductor to the apparatus connected, the rule, or rather misrule, being apparently to use any casual tag end of scrap stuff which happens to be handy. The 50-amperes rule might for all intents and purposes be non-existent, nor does the sight of a mazy network of wires seem to excite much comment nowadays. Given a good earth connection,

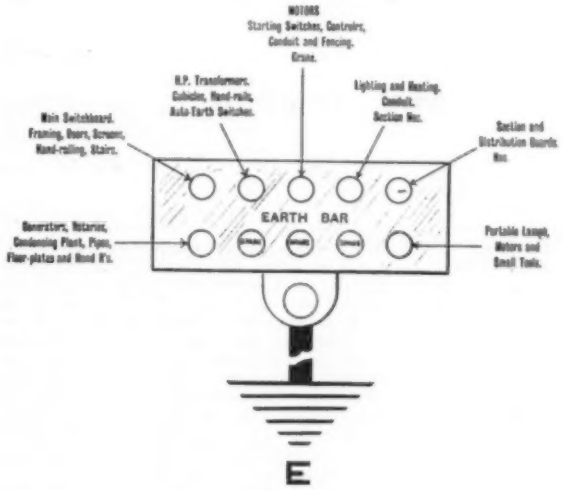


FIG. 7.

and that surely is a straightforward piece of engineering, what could be easier than to effect a sound connection of 100 per cent. conductivity electrically and mechanically thereto?

In dealing with apparatus and installations of all but the very smallest sizes, the writer would advocate, with due consideration to the circumstances of each individual case, the provision of one or more earth connecting points, these being situated as centrally as possible in relation to the apparatus connected thereto. Preferably made of copper bar or plate of ample capacity, the "earth bar" would be provided with a sufficient number of connecting points, all contact surfaces being accurately faced; the conductors of incoming circuits, if of standard cable, should terminate in properly-fitting

soldered thimbles having ample contact area. After naming, the circuits should be labelled suitably in an easily read position. The method referred to has many advantages over the usual network of innumerable lengths, jointed and otherwise, of multi-sized conductors and loop connections as commonly used, and, further, is more elastic and less expensive to install than the "ring main" or any of its modifications. The sketch, fig. 7, shows in diagrammatic form the arrangement described.

The indiscriminate use of water pipes for electrical earthing purposes, especially on large power systems, is open to many objections, and possibly in the not distant future their employment as such may be more stringently regulated than at present. Curiously, very little information of an authentic kind concerning the effects of electrolysis on underground water and gas-pipe lines or other subterranean media liable to attack is readily available, the published matter on this interesting subject being both scarce and meagre. Rarely are buried earth connections examined visually, or even tested, until perhaps occasion demands through trouble arising. When brought to light the condition of earth plates after long service is invariably interesting, and not infrequently past unsolved problems become readily explained, as likely as not without the aid even of the simplest arithmetic. A wider use might with advantage often be made of independent earthing apparatus, not only the best forms of the conventional earth plate, but of the lesser known proprietary devices. A good connection with "earth" is often difficult, but not impossible, to attain, and the location should always be carefully chosen to ensure as far as possible permanent and suitable strata, natural if possible, the earth device being preferably sunk upright, and the "bedding" properly packed, and if artificially maintained, means taken to obviate undue mechanical strain being put on the earth conductor and connections.

The time would seem not very far distant when some radical change may come about in the methods of installing interior wiring at any rate. Metal conduit in its many different forms as used to-day may then find its way into the melting pot, so to speak. Admittedly the best of the existing methods of enclosing wiring, it cannot be denied that screwed steel conduit has many inherent disadvantages; it lacks flexibility as regards adaptability to existing architectural structures, is complicated and unwieldly, and is open perhaps to criticism from an æsthetic point of view. Even with the many ingenious devices and accessories provided, the system does not facilitate fault-finding, renewals, and repairs. Moreover, on the score of first cost, the screwed conduit system of to-day is expensive often to a prohibitive degree. One feels moved to ask: Is not extreme mechanical strength for conductor protection somewhat of a fetish, and must we perforce always clothe wiring with steel?

The past decade or two has been singularly lacking in evolving a really practicable system of wiring on original lines, meeting modern requirements efficiently and economically. We do not seem to get very far beyond the conventional metal tube or some variation or other of the lead or alloy-wrapped methods of running wires, except the ancient and barbarous "open" method which periodically crops up in re-christened guise. The early 'nineties saw the birth of various concentric systems, wonderful inventions of their kind, and although now obsolete and out of fashion, examples are not wanting of their lasting qualities which are working satisfactorily to this day. An ideal system would seem to lie upon lines at once affording safety of working and sufficient and ample internal protection to the wiring without the aid of external secondary protection. Such a consummation would then probably pass from the purview of Regulation 21, or at least the decree would undergo considerable revision, and thereby be rendered easier of understanding by those who have to work to it.

The writer has attempted to deal critically with the earthing of apparatus from a practical standpoint, and has purposely avoided making reference to the special Mining Rules, as these hardly come within the range of the foregoing notes.

THE TEMPERATURE LIMITS OF LARGE ALTERNATORS.

By G. A. JUHLIN, M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers.)

Report No. 72, by the British Engineering Standards Association, deals comprehensively with the whole of the above subject. Comparatively few specifications for electrical plant are, however, based on these Rules. It is not uncommon to find that the methods of measurement laid down in the Rules are adopted, but that the limiting temperatures specified are generally very much lower. This may be due partly to the temperature rises allowed in the Rules being higher than those that engineers are familiar with, and partly to a doubt whether insulation will safely withstand these temperatures. Experience has shown that such doubts are groundless and that mica insulation is capable of withstanding considerably higher temperatures than those laid down in the Rules.

In considering temperature conditions of the stator, we shall neglect the influence of the rotor upon the stator temperatures. The change in temperature of the different parts of the stator with the load, as shown in fig. 1, is typical of large turbo-generators with long cores. In machines with short iron lengths, the temperature of the stator copper embedded in the iron may, at no load, be considerably below the temperature of the iron, due to the heat from the latter being conducted from the embedded portion to the end windings with a very small drop in temperature. Fig. 1 shows that the temperature of the iron increases with the load, due to the fact that in large turbo-generators the greater portion of the losses caused by the load current is generated in the laminations and the surrounding iron, the losses in the copper itself being a comparatively small portion of the total load loss. The temperature rise of the iron at any given load will then be a function of the total losses in the iron at this load and of the volume of cooling air.

Figs. 2 and 3 show the conditions obtaining with radial and axial ventilation respectively. The situation of the hot spot changes with the type of ventilation, but it will be somewhere in the embedded portion of the winding, unless the ventilation of the end windings is abnormally bad. The heat will then flow from the hot spot along the conductors towards the end windings. The amount of heat to be transmitted becomes greater towards the ends, due to each unit of length generating heat, which must be added to that of the preceding part of the conductor.

The amount of heat generated per unit length is not constant, on account of the varying temperature of the copper, and the temperature drop, therefore, increases very rapidly with the length of the conductor. Fig. 4 shows the temperature gradient for varying lengths and current densities. These curves are based on the formula of Prof. Miles Walker and also on the assumption that all the heat is conducted along the copper. Such large temperature differences do not actually exist in practice, as a considerable amount of heat is transmitted through the insulation, but the curves indicate the comparatively small amount of heat which can be conducted along the copper without excessive temperature differences.

In calculating these temperatures no account has been taken of eddy-current losses. The temperature drop would be greater than indicated by the curves if there should be no heat transmission through the insulation, and in machines with long cores practically all the heat generated in the centre of the conductors must pass through the insulation into the lamination. In taking into account the losses caused by eddy currents, it should not be overlooked that these losses diminish with increasing temperature, whereas the normal I^2R losses increase. Accurate calculations are, therefore, very complicated and tedious.

Experimental work has been carried out to determine the thermal conductivity of different classes of insulation. The difficulty in applying the data thus obtained to a completed machine lies in the fact that the thermal conductivity depends to a great extent upon how tightly the insulation is applied on the coils, and on the clearance existing between the outside of the insulation and the laminations. No definite values

which may be applied generally can be given. Tests made on complete machines in actual service show that a thermal conductivity of 0.003 to 0.0035 watt per cu. in. per deg. C. may be taken as an average figure. These values were obtained on coils insulated with mica wraps applied under heat by a special wrapping machine. Having fixed the value of the constant, the temperature drop $T=(W\times t)/c$, where W= watts per sq. in., t=thickness of insulation in in., and c= thermal conductivity.

To determine the watts per sq. in. it is necessary to include the eddy-current losses in the copper, as these may be very large if the winding is not properly constructed. For this reason it is impossible to judge the rating of a machine by simply specifying that the current density must not exceed a certain value, because one machine may be run with, say, 2,000 amperes per sq. in., and yet have a lower temperature rise than another machine of similar size having a density of only 1,500 amperes per sq. in. Moreover, the proportions

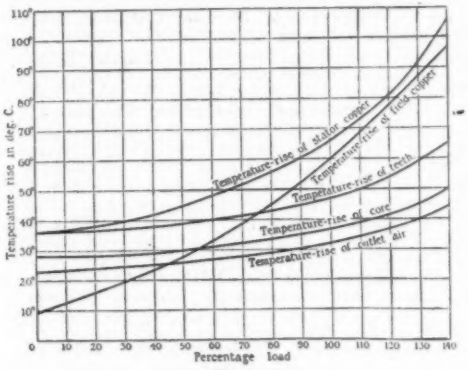


Fig. 1.

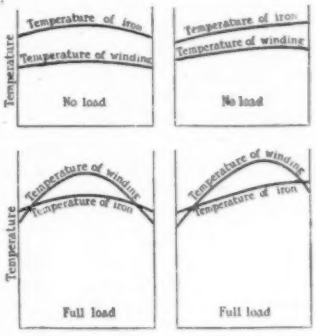


Fig. 2.

Fig. 3.

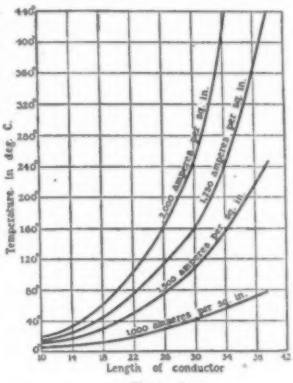

Temperature in deg. C.
Length of conductor
1,500 amperes per sq. in.
1,200 amperes per sq. in.
1,000 amperes per sq. in.
1000 amperes per sq. in.

Fig. 4.

Fig. 1.—Variations in Temperature Rise of Different Parts of a Large Alternator, due to Change in Load.
Fig. 2.—Axial Temperature Distribution in Stator, with Radial Ventilation.
Fig. 3.—Axial Temperature Distribution in Stator, with Axial Ventilation.
Fig. 4.—Temperature Drop for Different Lengths of Conductor.

of the slot have considerable influence on the temperature rise which will be obtained with a certain current density, so that this value is no criterion as to liberality of material in a certain design.

Consider a slot, fig. 5, and assume that all the heat generated in the copper conductors at the centre of the core has to be transmitted laterally through the insulation from point A to point B. Assume a temperature rise of 40 deg. C. on the laminations, as measured on the surface, and allow 10 deg. C. for the difference of temperature between the point B and the surface of the laminations. If the temperature of the inlet air be taken as 15 deg. C. the final temperature of the point B will then be 65 deg. C. Assuming the watts per sq. in. of surface to be 0.7, and the thickness of the insulation to be 0.12 in., the temperature drop from A to B would be:—

$$T=(0{\cdot}7\times 0{\cdot}12)/0{\cdot}033 = 28 \text{ degrees C};$$

the total temperature of point A would be 93 deg. C., and the temperature rise 78 deg. C. above the cooling air. For a 10,000-volt machine, we should obtain a temperature drop from A to B of 48 deg. C., and a total temperature at A of 113 deg. C. The temperature rise would be 98 deg. C. above the cooling air. These figures may seem high as compared with the conventional figure of 40 deg. C. measured by thermometer, but in reality they are not in any way excessive, for if the temperatures of existing machines were measured they would probably be found to be in the neighbourhood of these figures, if not higher.

Higher internal temperatures will be met with in high-voltage machines than in low-voltage ones, if the same surface temperatures are specified. This has been recognised by the British Engineering Standards Association, and it follows that higher surface temperatures may be permitted for low-voltage machines than is the case for high-tension machines, without exceeding the internal temperatures of the latter. In addition to the temperature drop through the insulation there will be a temperature gradient in the stator laminations, the temperature decreasing towards the outer periphery.

The difference in temperature between the iron at the root of the teeth and the outer periphery depends on the losses in the laminations, and on the radial depth of the core and the system of ventilation adopted. The temperature conditions of the stator winding in the slot and of the laminations as regards the radial direction are shown in fig. 6.

The thermometer method of temperature measurement is the simplest and, so far as surface temperatures are concerned, the most reliable.

A closer approximation of the true internal temperatures can be obtained by the use of the increase-of-resistance method, which will only indicate the average increase in temperature of the whole winding, but it will nevertheless give a very close indication of the internal temperatures of the winding. The discrepancy between the internal temperatures of the copper and those obtained on the external surface is frequently lost sight of in preparing specifications, for manufacturers are not infrequently asked to quote for machines having a temperature rise of 40 deg. C. as measured by resistance. Machines built to meet such conditions would be very expensive and wasteful as regards material, besides being inefficient on account of their size for a given output as compared with those built for a higher temperature rise. The margin of safety on such machines would be beyond the requirements of even ordinary cotton insulation.

Embedded temperature detectors have received comparatively little attention in this country as a means for determining the temperature of machines in commercial operation. In America this method has been adopted as a standard, and machines are now generally provided with embedded temperature detectors during construction. Special instruments are provided, so that the temperature of the different parts of a machine can be read at any time. Some of the advantages from the operating point of view of such an arrangement are obvious, whereas others are not so apparent. For example, consider a machine the stator winding of which is insulated with mica on the embedded portion and by fibrous material on the ends. The limits for the temperature rise laid down by the British Engineering Standards Association for fibrous insulation are 55 deg. C. measured by resistance, or 50 deg. C. by thermometer, with certain reductions for high voltages, and as a portion of the winding is insulated by fibrous material these limits must be applied for a machine insulated as described. The temperature rise permitted for mica insulation is 75 deg. C. by resistance method, but it is not possible to take advantage of this higher limit owing to the fact that, as the end windings are insulated with fibrous material, the temperature rise for the whole winding must not exceed that specified for fibrous material. In such a case it would be advantageous to measure the temperature rise of each portion of the winding independently.

The effect of short-time overloads is of importance from the temperature point of view. Referring to fig. 1 the drop of temperature through the insulation increases very rapidly with the load; at the same time, the temperature drop through the iron is increased to some extent. Consider a machine required to give 50 per cent. overload for half an hour. Experience has shown that the windings reach their maximum temperature in less than an hour, starting from cold, and would reach a steady temperature due to the overload in well under the half-hour, starting hot. The large temperature gradients in the insulation and the iron cannot be measured by thermo-

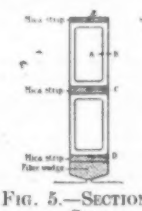


Fig. 5.—Section of Slot.

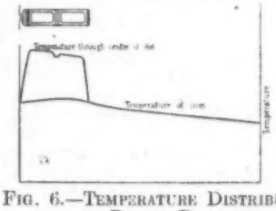


Fig. 6.—Temperature Distribution in a Radial Direction.

meters, but by the use of embedded temperature detectors we shall be able to determine very closely the actual temperature of the copper, and thus prevent the machine being overheated. Similarly they will enable operating engineers to take full advantage of the capacity of a machine and operate it up to the ultimate hot-spot temperature permitted for the class of insulation employed. When embedded temperature detectors are used, the temperature guarantees should be based on the total temperature and not on a specific temperature rise based on a given air temperature. The advantage obtained by operating large turbo-alternators on this basis deserves consideration. Consider two identical machines, one

operating on the basis of a given temperature rise with a fixed value for the air temperature of 40 deg. C., and the other on the principle of a maximum total temperature. The average air temperature in this country is less than one-half of the assumed air temperature of 40 deg. C., and it is obvious that we are not taking advantage of the permitted temperature limit of the insulation when operating on the temperature rise basis. By providing embedded detectors it is possible to take full advantage of low cooling-air temperatures, as readings can readily be taken at any time.

During the winter months the difference between the actual air temperature and the basis temperature will be still greater and, when it is considered that the load usually is heavier at this time of the year, the advantage is of considerable value in augmenting the output of a station at a time of heavy load. Taking fig. 1 as a basis, we should reach the maximum permissible temperature rise based on an air temperature of 40 deg. C. at 115 per cent. full load. Assuming an air temperature of 15 deg. C., which is, if anything, rather high for the winter months, we should be able to run at 140 per cent. full load without exceeding the total temperature on which the temperature rise reached at 120 per cent. load was based, *i.e.*, 120 deg. C. In operating on the temperature rise basis we lose 18 per cent. of the output the machine would be able to give if run up to the limiting total temperature.

Basing the increase on the average air temperature throughout the year, the increase in output would probably be not more than 10 per cent., but even at this figure the saving in capital expenditure on a 20,000-kW set would be very considerable. The possible increase in output depends largely on the design, and the increase in load given above may not always be realised, but the air temperature is frequently lower than 15 deg. C., and the lower this value the greater is the increase it is possible to obtain from the alternator. The rating of large plant on the basis of ultimate temperature is standard practice in America, both for turbo-alternators and for water-wheel generators. The practice is also becoming general in Scandinavia. The thermo-couple is the most satisfactory means for measuring internal temperatures, owing to the small space occupied which makes it possible to measure the temperature of any particular spot in a machine.

A detector placed at the point B, fig. 5, between the coil and the slot lining, which is generally introduced between the coil and the lamination, would indicate a temperature between that of the copper and the iron. If it were placed between the two coils at the point C, the reading obtained would closely approximate to that of the copper itself, for the reason that there is practically no heat flow between the two coils, except the very small amount which will flow through the edges of the packing strip between the two coils. This amount will be almost negligible, unless the strip is very thick, and for this reason it is desirable to reduce this packing to a minimum. The temperature at point D will also approximate to the copper temperature, although not so closely as at C. A certain amount of heat will be transmitted through the wedge, but, if this is thick as compared with the coil insulation, the drop through the insulation will be comparatively small. By providing substantial insulation between the coil and the lamination at the bottom of the slot, and placing the detector between the strip and the coil at E, we should obtain a temperature varying but little from the true copper temperature. American standard rules specify that, when there are two coils per slot, detectors are to be placed between the coils, *i.e.*, at C, and if only one coil per slot is used it must be located at the bottom of the slot. It is hoped that operating engineers will encourage the provision of detectors, and thus put manufacturers in a position to gain experience which cannot be obtained by running machines light at the works. Insulation which, if not disturbed, would last almost indefinitely, would fail very quickly if subjected to vibration or shocks.

(To be concluded.)

ELECTRONS.

By SIR WILLIAM BRAGG, K.B.E., F.R.S.

(The twelfth Kelvin Lecture, delivered before The Institution of Electrical Engineers.)

(Concluded from p. 127.)

Keeping the foregoing results in mind, we can now appreciate a very remarkable development of electron theory which has been made in the last few years. Spectrum analysis has long been occupied with the extraordinary complications of the radiation emitted by the various atoms. As a result it appears that the frequencies of the lines in a spectrum often display curious and exact numerical relations, in the form generally involving differences of frequencies of similar lines or groups of lines. For instance, the famous Balmer equation

Frequency $= v = N\ (1/n_1^2 - 1/n_2^2)$ where $N = 3.290 \times 10^{15}$

gives the frequencies of series of lines in the hydrogen spectrum. When n_1 is put equal to 2, and n_2 to 3, 4, 5 in succession, the series of values for v represent the frequencies of the lines in the visible spectrum. If $n_1 = 3$ and $n_2 = 4, 5, 6, \ldots$, in succession, we have the frequencies of lines in the infra-red (Paschen) and if $n_1 = 1$, $n_2 = 2, 3, 4, \ldots$, we have the frequencies recently shown by Lyman to exist in the ultra-violet.

Now there is nothing in our older conception of the origin of radiation within the atom to give us a clue as to why differences of frequencies should come into these empirical though most useful formulæ. We have pictured to ourselves vibrating systems, mechanical or electric, and waves arising therefrom. But what connection between masses or electricities gives us in any simple way equations involving the addition or subtracting of frequencies? We are in a blind alley. Let us, therefore, abandon our preconceptions as to the origin of those lines which we find in the light spectrum and suppose that here also they arise in the same fashion as we actually know that they arise in the cases we have considered above. Suppose that the energy of an emission of radiation is derived from the energy of an electron. It may be the only way in which radiation ever does arise, but it is not necessary to suppose so much at present. It is enough that we carry into the atom the whole process which in X-rays and the photo-electric effect we have observed to take place in part outside. Suppose that within the atom there are certain positions or conditions in which electrons *may* be, each postulating a certain energy content for the electron; and suppose that sometimes an electron slips from one position to another of lower energy, and that the difference in energies is transformed into wave radiation according to the same law as before, *i.e.*, energy transferred $= h \times$ frequency. Let the energy in these states be Nh_1; $Nh/2^2$; $Nh/3^2$; &c., and so on. Then Balmer's is accounted for and the other series at the same time, and the peculiar form of these equations.

What may these states be? Why not, as Bohr suggests, so many different orbits in which electrons can move round the central positive nucleus in the atom, the nucleus whose sure existence Rutherford has established? At one time if we had presumed the existence of these orbits we should have been inclined to connect them with the direct emission of radiation, and the frequency of that radiation would be the number of revolutions in a second. But now, we assume these orbits to persist without radiation, and that radiation arises where the electron steps from one orbit to another; moreover, the frequency of the issuing radiation is determined by the simple rule, frequency is equal to change of electron energy divided by h. We are not picturing any new process here, or evolving new ideas to fit awkward facts; we are supposing a process to exist in one place which we already know to exist in another.

It is a very remarkable fact that the number N is equal to $2\pi^2me^4/h^3$ within small errors of experiment. Spectrum measurements show that N is equal to 3.29033×10^{15} and $2\pi^2me^4/h^3$ is equal, taking the most recent determination of m, e, and h, to 3.289×10^{15}. An electron revolving about the central positive nucleus of a hydrogen atom (having a positive charge), and possessing the amount of energy Nh or $2\pi^2me^4/h^2$ moves with a velocity $2\pi e^2/h$ and has an angular momentum equal to $h/2\pi$. The electron if it moves in the next ring does so with an angular momentum $2h/2\pi$ and so on. We can, therefore, following Bohr, define the necessary separate states as those of motion in circular orbits in which the angular momentum is an integral multiple of $h/2\pi$. The simplicity of these expressions is very attractive. But the matter is far from ending here. During the last few years Bohr and Sommerfeld have led an inquiry into the possibilities of this theory which have led to very remarkable results. These are due to a slight modification in the original conception. The different circular orbits which Bohr first pictured have become groups of orbits fixed by laws which are somewhat arbitrary, but not without foundation. A group contains a limited number of orbits in which the electrons may move, and each group corresponds to one of the original circular orbits. Some of the orbits in each group are elliptical. It appears that the energy of the electron would be the same in all the orbits of any one group were it not that when an electron moves in an ellipse its velocity is not always the same. Now a fast-moving electron shows a variation in mass when its speed alters, and this does affect slightly the energy of the orbit. Consequently, the electron that steps from an orbit belonging to one group to an orbit belonging to another group may part with an amount of energy which is not always exactly the same. The frequency of the consequent radiation may, therefore, have two or more values differing slightly from each other; the single spectrum line is doubled or trebled. This is what Sommerfeld calls the "fine structure" of the lines.

Now there is far more than mere speculation in this. The formulæ which Sommerfeld gives as the result of an analysis which is as reasonable as can be expected, does more than account for known effects; it has predicted the existence of numerous lines, and even their intensities, and the predictions have been verified by experiment in the most remarkable way. The story is told in Sommerfeld's work on "Atom-building"; a story of the work of himself, Bohr, and others during the last six years or so.

We see that in this fundamental inquiry into the nature and properties of radiation, the electron plays a very direct and important part. Our eyes are designed to detect waves, not electrons, and so our first attention is directed to radiation in wave form. But we now find that radiation energy may alternatively be carried by electrons, and that many things become clearer when we appreciate this fact. We can only

make further progress in our understanding of radiation, and indeed in our understanding of the electron, by getting to know more about the reciprocal conversion of one form of energy into the other, since evidently it is one of the most frequent and most fundamental operations in nature.

So far our conception of the structure of an atom would consist of a positive nucleus, and electrons attached thereto in the same way; with the further idea that the energy attached to these electrons can only have certain definite values. Bohr assumes that they have these values because they can move round the core in certain orbits only; and Sommerfield enlarges this idea as already explained. But, of course, this can only be a partial picture of the whole atomic structure. The atom so conceived cannot fill the part required of it in the building of molecules and crystals.

When we come to examine these structures we find atoms attaching themselves to each other through the action of forces which cannot always be considered as acting from centre to centre. For instance, the arrangement of the carbon atoms in a diamond, as recently determined by X-ray methods, is such that every atom is at the centre of gravity of four others, arranged round it in tetrahedral fashion. The representation of an atom by a smooth sphere and nothing more would be in agreement with the idea that the properties of the atom in any one radial direction are exactly the same as in any other radial direction, and that any forces between two atoms are between centre and centre. For instance, it has been suggested by Born and Laudé that the force between two atoms may be of the form $a/r^2 - b/r$. This gives an attraction at great distances and a repulsion at small distances, so that the atoms close up together but stay at a certain distance apart as if they possessed surfaces which pressed together. But if that were the case, the carbon atoms would pack themselves together more closely than they do. As a matter of fact, just twice as many atoms could be packed into any volume as there are already there. We must conclude that there are definite sub-centres of force on the outskirts of the atom; and that in the carbon atoms of which the diamond is composed there are four such sub-centres arranged symmetrically, that is to say, in tetrahedron fashion round the core.

Must not these sub-centres be electrons? And if so, must we not take them to be circulating in small orbits about a local centre? Or, perhaps, as Parson has suggested, the electron is ring shaped, the electricity revolving round the axis of the ring. In this way we should have electromagnetic forces to link the atoms together.

It is very interesting to observe that in any case the carbon atoms in the diamond are not all oriented in exactly the same way. Taking a cleavage or tetrahedral plane as that of reference, half the atoms will be pointing towards the plane and their neighbours will be pointing away. This ought to make a difference to the X-ray spectra; and it has been looked for at various times, but without success. Lately, however, the improvement in the X-ray spectrometer has been considerable, and I now have no difficulty in finding the expected effect. It is clear, I think, that the carbon atom in the diamond is to be represented as to its properties by a tetrahedron; and that the atom has different properties in different directions, or, as the chemist would say, has directed valencies. There can be little doubt that this is so in all atoms. The suggestion is that some of the electrons are tied down to certain regions on the surface, and that not all, if indeed any of them, are at all times revolving round the central core.

When atom joins up to atom it is these sub-centres that are at work; and since atom to atom and again atom to atom make in the end the crystal, and since the crystalline structure is the basis of all solid structure, and is fundamentally concerned with the strength of materials and their temper and all their physical properties, it is easy to see how great is this minute study of the electron.

If this conception of fixed electrons seems to clash with the orbital motions of Bohr and Sommerfeld, we must remember that the clash is between two pictures both of which are, we know, imperfect. We may expect that on the next occasion when a lecturer tries to tell you what advance has been made in the study of electrons some of these contradictions will have disappeared. Whether this is so or not, I am sure of this, that in the attempt to realise the properties of nature's unit, the electron, we are working in the true direction towards an understanding of the great problems of radiation, and of material structure.

REVIEWS.

The Electricity (Supply) Act, 1919, with Notes. By W. S. Kennedy, Barrister at Law. Pp. 96. London: Electrical Review, Ltd. Price 3s. 6d. net.

This is a small book giving the text of the Act with conveniently arranged footnotes and comments. The author, in the preface, states that the Act "appears to be an honest attempt to get rid of obsolete barriers and to bring together those responsible for the supply of energy" so that it can be "more freely and easily created and distributed"; and he later states, "When the legislature, not content humbly to pave the way for the scientist and practical engineer to tread, ventures to attempt creation on its own account, the result is sometimes not harmful because it is ludicrous." The "attempt to provide cheap electrical energy by Act of Parliament is one beside which Canute's task was a hopeful one."

The notes in the book follow each section, and they are more useful and intelligible to the lay reader than is the case with many legal works. The reviewer's notes are bracketed.

Section 1 of the Act deals with the Commissioners and their powers. The author points out that it is the first of the Electric Lighting Acts which recognises the value of electricity "supply" for purposes other than illumination; also that the Act does not point out the source from which the Commissioners' office and other expenses are to be paid, and it is presumed that these will be paid by the industry generally. (It is to be hoped in the interests of the industry that the staff will not be extended like that of the rest of the Transport Ministry, otherwise the fees will have to be much greater than those found necessary, under somewhat similar circumstances, by the French Government.)

Section 2 provides that the powers of the Board of Trade under the Electric Lighting Acts may be exercised through the Commissioners, and it is pointed out that by Section 39 of the new Act, by Order in Council, the powers shall be transferred to the Transport Ministry, which can apparently refer matters to the Commissioners or not as it thinks fit. Section 3 gives power to the Commissioners to conduct experiments. (In France a Committee supported by electricity supply authorities and manufacturers, with the assistance of the Government, is at present conducting experiments regarding the construction and ageing of high-pressure insulators; similar experiments would be of great value here.)

Section 4 enables one or more Committees to be appointed by the Commissioners to advise and assist on matters connected with development and supply, the members being drawn from "Joint Electricity Authorities," authorised undertakings, or other specially qualified persons. (It is to be hoped that sound business men and not popular political busybodies will be asked to assist on such a Committee.)

Section 5, dealing with the reorganisation of supply, is one of the most important in the Act, as it deals mainly with authorities and areas of supply. The notes on this section are of a detailed and useful character. It is pointed out that Sub-section 3, if the Commissioners do not approve of any scheme, empowers them to evolve one of their own; but that an undertaking cannot be transferred to a Joint Authority without the consent of the owners except by means of an indirect method through the use of Section 24, which will be noted later.

By Section 6 representative Joint Electricity Authorities, with wide powers, may be set up in districts, the members being drawn from local bodies and large consumers. Notes extending to four pages are given regarding the powers of Joint Electricity Authorities. Past obstacles to co-operation are pointed out, especially the Electric Lighting (Clauses) Act, 1899, which practically prohibited the "associating of local authorities and companies." (In France, for example, where somewhat comparable conditions exist, it has been recognised that the advantage of co-operation by suppliers outweighs the dangers of electricity "combines," even where the bulk of the electricity supply is in the hands of companies.) The new Act removes this obstacle. Some useful proposals regarding the formation of Joint Authorities are given in the notes. The author states that there are three practicable schemes: Where the authority takes over the whole of the undertakings; where it generates, but does not distribute; and where it distributes only. The scheme does not allow of the taking over of part of an undertaking except with the consent of the owners. A transfer to the authority can take place on agreed terms, but the source of the fund from which the price is to be paid is not stated. Apparently no compensation is to be given to directors of companies for loss of fees on transfer to an authority. (This policy differs from that adopted when the London water supply companies were dissolved on the formation of the London Water Board; perhaps if company directors formed a trade union and made a noise, their claims would be considered.)

Section 7 deals with the confirmation of schemes which must be subject to a resolution of Parliament. By Section 8 it shall be the duty of the authority to provide a "cheap and abundant supply of electricity." In the notes it is rightly pointed out that the cost of electricity will be largely determined by the cost of fuel and labour, though it is stated that the substitution of modern systems and the scrapping of obsolete plant may produce considerable economies and that the removal of legislative restrictions may lead to a more abundant supply. (In this connection it is not usually remembered that owing to the enormous capital cost of new plant as compared with old, and the high capital charges therefore involved, the advantages of scrapping old plant are not as great as would appear at first sight.)

Section 9 deals with the powers of a Joint Electricity Authority to acquire "any generating station." (In Section 36 of the Act, which is devoted to definitions, that of a "generating station" and that of a "private generating station" are given, and apparently the former includes the latter, so it looks as if an authority can take over a private generating station by agreement.) Section 10 deals indirectly with liability for nuisance. In Section 11 the establishment or

extension of public or private generating stations or main transmission lines is dealt with, and also the supply and sale of surplus power. It is pointed out that it is not competent for existing statutory undertakings to purchase or install new plant without the consent of the Commissioners, and further that in the event of the sale of surplus power the prices to be charged must be those which the Commissioners think fit and proper. (The powers of the Commissioners in this section are distinctly arbitrary, and as there is a fashionable bias in official circles against private enterprise, it is not altogether desirable that such powers should be exercised without the right of appeal to the Law Courts.)

Section 15 deals with condensing water; the utilisation of water power, waste heat, and other forms of energy; the erection of by-product plant; and the handling of residual products. By this section it appears that power gas, low-pressure steam, or even hot water could be supplied by a Joint Authority. (It might be noted that in the Ruhr Valley in Germany power gas from coke ovens is being distributed through many miles of mains over a large area, to the material relief of railways, and this is probably a very economical form of distribution of heat energy.)

Section 16 deals with the compensation of officials for loss of employment or variation of conditions due to the transfer of any undertakings under an improvement scheme. By Section 17 a Joint Authority, before exceeding some prescribed capital expenditure, must obtain permission of the Commissioners and submit plans and estimates. In Section 18 permission is given to the Board of Trade during the transition period to construct any generating station or transmission line, and exercise the powers of a Joint Electricity Authority to the capital cost, if required, of twenty million pounds. Useful notes are given regarding this section. (Considering the policy recently adopted by the Transport Ministry regarding the Severn power scheme, it is to be hoped that this permission will not lead to the duplication and multiplication of officials.)

Section 19 gives powers by which, during the transition period, two or more undertakers may mutually assist one another. The notes point out that this removes one of the oldest and most vexatious restrictions to electricity supply. Section 21 practically removes the right of veto by local bodies to the construction of overhead lines. (It is to be hoped that the Electricity Commissioners will show more sympathy in this respect than the Board of Trade did not so long ago. Perhaps in case of doubt Mr. Pearce, of Manchester, might now be willing to assist.) Section 22 provides facilities for wayleaves over any land except gardens, across or along any railway or canal, subject in cases of dispute to the approval and conditions of the Board of Trade.

Section 23 allows a Joint Electricity Authority or any local municipal or urban supply undertaking to let out on hire wiring, fittings, and apparatus, but not to manufacture or sell the same unless expressly authorised. Section 24 deals with the powers of the Commissioners to alter the type of current, frequency and pressure of supply to be employed by an undertaking. It is pointed out that this is one of the few compulsory powers in the Act. (In the past undertakers have spent large sums in capital and maintenance for rotary substations required for the supply of direct current in areas distant from generating stations; presumably this clause will facilitate the supply of three-phase energy to customers.)

Section 22, sub-sections 4 and 5, and Section 25 deal with the protection of lines controlled by the Postmaster-General, the existing law being confirmed. (In view of the developments which have taken place regarding power transmission, the preference given to the Postmaster-General should be abolished, and the unfair action taken in the recent case of the P.M.G. *v.* The Blackwood and Fleetwood Tramroad Co. shows that he is anxious to claim his legal rights. Electricity supply is as much a public utility as the telegraph or the telephone system, and where interests clash they should be decided, not by any statutory preference, but by balance of public convenience. The time is past when the Post Office should demand that its rights should be enforced and continued under Acts drafted before electric power was thought of. The claims of the Post Office should stand on their own technical merits; in these days any favoured position demanded by a local or national bureaucracy is a confession of weakness if not incompetence.)

Section 26 deals with provisional and special orders, the veto of local authorities being practically removed. Section 27 deals with statistics, 28 with finance, and 29 with expenses of the Commission. The remaining clauses of the Act are comparatively unimportant. (As with the housing question, it may be very much easier to make programmes than to find money and get work carried through, and while the Act removes many obstructions and gives many facilities, improvements will probably have to take place regarding interest on capital and output of labour before very much can be done under it.)

The book is well printed, although it would have been easier to refer to if a different print or width of column had been used for the explanatory notes. Many legal books have been written which are little more than reprinted Acts of Parliament with the help of a little "scissors and paste," but in this book the notes have the merits of being useful and somewhat original in style. The book should be on the shelves of lawyers and laymen who are interested in electricity supply.

T. R.

EXTRA-HIGH-TENSION DISTRIBUTION BY UNDERGROUND CABLE.

Discussion at Newcastle-on-Tyne.

At Newcastle-on-Tyne, on January 24th, Mr. R. O. Kapp's paper on the above subject, which was abstracted in our issue of December 17th, was discussed before the North-Eastern Centre of the Institution of Electrical Engineers.

Mr. G. L. Porter opened the discussion, and said that their cables had been laid with a view to the future, but that future was with them now. He drew attention to the statement by the author that the principal point on which the e.h.p. distribution differed from l.p. distribution was that in the former case the limit to the capacity of the cables was almost always set by heating, whereas in the latter case it was more usually determined by voltage drop. In that district they frequently came up against voltage drop, but not heating, and that would seem to be what they might expect from Mr. Kapp's suggestion that cables not larger than 0.075 in. should be used because the heating was so much greater with larger cables. The contention that the cost of cable per kVA transmitted was less the higher the voltage was true, assuming that the cable was fully loaded, otherwise they would have to take into account other factors. Mr. Kapp suggested that the highest pressure at which they could sell power was 6,600 volts, but the speaker did not regard that figure as sufficiently high, for in that district power was sold at up to 20,000 volts. Referring to the cost of e.h.p. transmission in bulk, he suggested that the cost of step-down transformers should be taken into account. He drew attention to the illustration of the cost per kVA per mile and said it was rather a peculiar curve, because it looked as if it were approaching the horizontal. As a matter of fact, if the line were continued in a larger section it would start to rise.

Mr. Townley took some figures given by Mr. Kapp to be an argument against "super-stations." He showed some figures which made the charges for sinking fund and interest almost equal to the cost of coal. Mr. Kapp said that a supply undertaking would have to include in the average charge per unit a figure which might be as low as 0.05d., or as high as 0.22d., to cover capital charges on e.h.p. distribution, and for very large power schemes it might be considerably higher; by comparison it might be hoped that the cost for very large power schemes might be 0.28d. per unit. Taking coal at 30s. per ton, not an unreasonable charge now, it worked out at 1.75d. per unuit. Was it the unit at the busbars, or the unit that was sold, that was taken as a basis in those calculations? In many areas the water supply decided the position of the station; water was often supreme in importance.

Mr. C. Turnbull pointed out that the location of the station was not only interesting, but important. Often when they were laying out a scheme they did not really know whence the load was coming, but the station was placed on a site that was thought to be suitable, and then someone came along and built works in close proximity. Speaking of the amount of copper in a cable, he said that at present the cost of laying and reinstating cables was very serious, and they might be justified in putting in more than they really needed for the time being. The heating of cables was much the same as the heating of transformers, &c. The speaker criticised the "clover leaf" cable; the design was a complete mistake, it was not much cheaper and carried, in his opinion, less current; the conductors were far too close together, and they could not get rid of the heat in any way. With regard to tariffs, for consumers, he supposed that all had felt in the past that they had no right to penalise the consumer just because he did not happen to be situate near the power station. At first it seemed just that they should get off any extra charge, especially persons building works, but he thought they might come to the point where they would have to create a tariff according to the cost of supply. At the same time he suggested that putting down a power station in such a site as would enable works to be built around it was a point worthy of consideration.

The Chairman (Mr. J. R. Beard) explained that the present state of affairs called for the greatest possible economy in their work. It was almost impossible to get money at reasonable rates; therefore, they had to use to the fullest extent the plant they had. He spoke of the high cost of apparatus made in England compared with that made in Switzerland.

Mr. R. O. Kapp, in his reply, said he was not in favour of "super-stations"; they got the cheapest electricity where the plant installed was about 100,000 kW, that was, taking the cost of cables and other capital charges into account. If they got much beyond 100,000 kW there was generally great additional cost for distribution, &c.

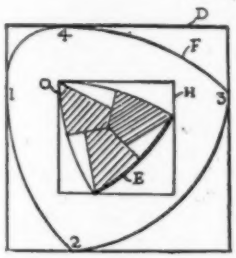
NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

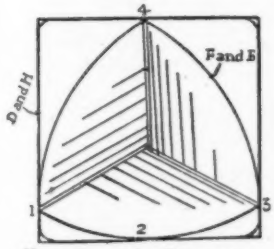
Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Radbore Drill Head.

The following brief description of the Radbore drill head, which is an attachment for drilling *square* holes, and is being placed on the market by The Lanston Monotype Corporation, Ltd., of 43, Fetter Lane, E.C. 4, will be of general interest.

After mounting the head, a simple operation consisting of clamping the head to the column of a milling machine, a drill of the required size is set in the jaws of the head and properly adjusted. The drilling of the square hole is done in only one operation and differs from that of drilling round holes in that the work is advanced against the drill. Two different sized heads are made, each taking a certain range of drills, and so arranged that the Nos. 4 and 5 heads together take all drills from ⅛ in. to 2 in. inclusive. Any hole drilled by the Radbore head may extend through the material, or may be of any desired depth with a flat bottom. Such work neither requires additional appliances nor consumes extra time. The drills are of two classes, one of which drills holes with sharp corners, fig. 1, and the other holes with filleted corners, fig. 2; the radius of the fillet is one-eighth the size of the hole. The life of these drills is exceptionally long, as all sharpening is done on the end; the flutes are never ground and therefore the size of the hole is never reduced. After the work required has been finished, the head can be removed and the machine put on other work. In the case of rectangular holes there is very little difference in the operations as compared with drilling a square hole. Either the drill is fed across the stock (for soft metals) or two holes are drilled overlapping one another. Hub keyways may be drilled from the end as there is no tendency for the drill to be led off, that is, half holes may be drilled as readily as square ones. The basic feature of the "Radbore" principle is that of cost reduction, and a skilled mechanic is not required to set the head. Proper sharpening of Radbore drills is absolutely essential; the three cutting edges must lie in one plane and meet in the centre at the proper angle. Sharpening is simple when the drill is held at the proper angle, and a special vice can be supplied, the jaws of which will hold either round or oblong stock, and the vice can be clamped on any standard milling machine table.





Figs. 1 and 2.—Diagrams Representing Drill Heads.

For cutting square holes with sharp corners line D represents the square opening in the chuck jaw (fig. 2); line F is the outline of the shank of the drill—note contacts 1, 2, 3, and 4; H is the hole being cut, and E is the cutting blade. The sharp corner is possible because the centre of the rounded one of the three corners of F is at O, exactly in line with one of the cutting edges of the blade E. This means that one of the three cutting edges finishes the periphery of the square hole. The cutting edge is led in straight lines parallel with the sides of D, and at each corner is pivoted about itself, leading out at right angles to its entering direction. For square holes with rounded corners the shank and drill are of the same size and made in one piece (fig. 3). Note the outline of the shank in this case and the four points of contact 1, 2, 3, and 4, which are always present at any stage of the revolution of the drill.

Fig. 3.—Radbore Drill Head.

The "Trump" Electric Soldering Iron.

In the case of electric soldering irons as commonly designed for from 200 to 250 volts the attempt is made to concentrate all the resistance necessary for the circuit in the heating element itself. The result is that the heat generated within the iron is in excess of that which it can radiate away, consequently the temperature of the iron is continually rising during use until, if left in circuit long enough, the fusion point is reached, and in any case the element is being overrun all the time, shortening its life. In the case of the "Trump" iron, which is a new product of the Ardea Vulcaniser Syndicate, Ltd., of 318, King Street, Hammersmith, W. 6, for the above-mentioned range of voltage either two irons may be used in series or an external resistance may be permanently placed in the circuit. The resistance is contained in a neat case which can be fixed to the wall or may stand upon the bench; it is shown in fig. 4, and is claimed to be a fool-proof device, there being no need to place the iron on a special stand or to actuate a switch. The iron becomes hot in a few minutes, and all the excessive loading is carried by the resistance. For 100/110 volts the element takes safely the whole loading and the external resistance is not required. The heating element is easily replaceable; after removing the three screws on the iron (two of which are visible in fig. 4) a new element (also shown) can be slipped in right away. The elements are not of the usual construction, inasmuch as mica is only used as auxiliary insulation, and then in such a manner as to make no severe demands on it. The first layer of heating ribbon is wound on a solid porcelain cylinder, the second layer being separated from the first by porcelain strips. Fig. 4 depicts the light-weight iron, the weight of the tool complete being just under 1 lb. The copper bit is drawn down from ¾ in. bar, and stands out 5 in. from the chamber containing the element terminals. The total length of the iron is 14 in., and the weight of the resistance case about 1.5 lb. On a 100-volt circuit the iron is connected direct to the mains and takes 2.7 amps., that is, 270 watts; the heavy-weight iron on a 200/250-volt circuit has a loading of 540 watts on the circuit, half of this, however, is expended in the external resistance or in the second iron when two are wired in series, giving the actual loading of each iron as 270 watts, which makes the bit just red hot when seen in the dark; the element is identical for all voltages.

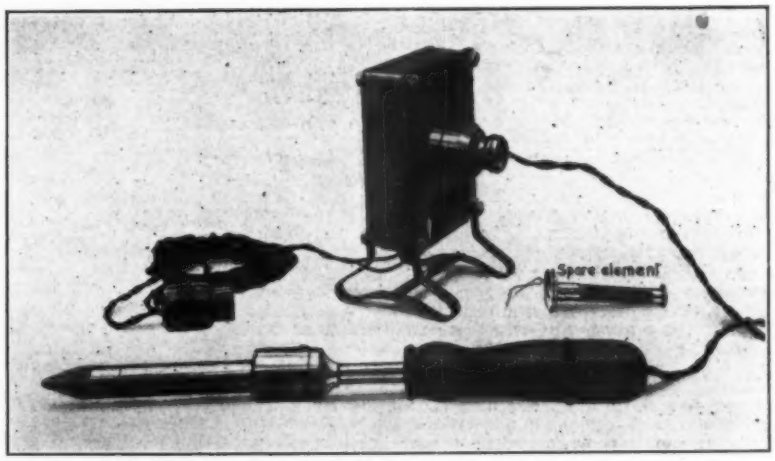


Fig. 4.—"Trump" Soldering Iron Outfit.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

1,293. "Determining distances by wireless telegraphy." W. Burstyn. January 10th. (Germany, December 15th, 1919.)

1,368. "Relays, and synchronised clocks, &c., operated thereby." Soc. Anon des Ateliers Brulle Frères. January 10th. (Belgium, December 13th, 1918.)

1,384. "Means for extinguishing arcs." Schweitzer & Conrad. January 10th. (United States, September 18th, 1916.)

1,486. "Crystal detector for wireless telegraphy." A. Bonnefont. January 10th. (France, November 13th, 1919.)

1,605. "Electrically-heated boilers." E. Meystre. January 10th. (Germany, December 5th, 1918.)

1,612. "High ohmic resistance." F. Krüger. January 10th. (Germany, November 27th, 1919.)

1,616. "Electric ignition apparatus for internal combustion engines." F. L. Madier. January 10th. (Germany, May 7th, 1919.)

1,633. "Electric welding." R. Mack. January 10th. (Germany, November 5th, 1919.)

1,635. "Strengthening electric oscillations by incandescent cathode tubes." Dr. E. F. Huth Ges. January 10th. (Germany, March 22nd, 1919.)

1,639. "Apparatus for production of undamped oscillations for telegraphy, &c." Dr. E. F. Huth Ges. and B. Rosenbaum. January 10th. (Germany, July 24th, 1919.)

1,649. "Telephone installations." Siemens & Halske Akt.-Ges. January 10th. (Germany, November 18th, 1916.)

1,653. "Device for electrically recording or reproducing motions." H. Meusser and E. Waltz. January 10th. (Germany, December 22nd, 1919.)

1,654. "Device for working power installations." Siemens-Schuckertwerke. January 10th. (Germany, December 12th, 1919.)

1,674. "Telephone indicators for central batteries." F. Mostovoy. January 10th. (France, January 9th, 1920.)

1,678. "Control of electric motors." Soc. des Ateliers de Constructions Electriques du Nord et de l'Est. January 10th. (France, December 13th, 1918.)

1,679. "Electric systems of ship propulsion, &c." Soc. des Ateliers de Constructions Electriques du Nord et de l'Est. January 10th. (France, May 25th, 1915.)

1,688. "Visible representation of electric signals." Neufeldt & Kuhne. January 10th. (Germany, May 12th, 1919.)

1,709. "Electric lamps for vehicles." G. Hookham and Kynoch, Ltd. January 11th.

1,720. "Sparking plugs." P. D. Peterson. January 11th. (Sweden, June 20th, 1920.)

1,740. "Swivelling shoe collector for collecting electric power from overhead conductor." F. H. Briggs. January 11th.

1,748. "Electric ceiling roses." J. Y. Fletcher and F. G. Quance. January 11th.

1,749. "Electric terminal couplings." W. J. Polyblank. January 11th.

1,750. "Plug-and-socket electric couplings." W. J. Polyblank. January 11th.

1,792. "Manufacture of telephone cables." C. F. Street and Johnson & Phillips, Ltd. January 11th.

1,795. "Incandescent electric lamps." F. Harrison. January 11th.

1,803. "Electric incandescent lamps." J. V. Ramsden. January 11th.

1,829. "Apparatus for electric ignition of flash powders." M. S. Dawson and J. G. Whittle. January 12th.

1,844. "Well globe fittings for electric lamps." T. Ions and Veritys, Ltd. January 12th.

1,845. "Wall fittings for electric lamps." T. Ions and Veritys, Ltd. January 12th.

1,870. "Automatic electric light switches." A. G. E. Electric Motors Ltd., Crompton & Co., Ltd., W. F. Jones, and H. C. Waters. January 12th.

1,891. "Means for preventing sagging of heating elements of electric fires." J. Y. Fletcher and R. J. H. Hill. January 12th.

1,920. "Platinum alloys." British Thomson-Houston Co., Ltd. January 12th. (United States, March 5th, 1914.)

1,934. "Means for unlocking magnetically locked lamps." C. Dawson and Davis & Son (Derby), Ltd. January 13th.

1,943. "Electro-magnetic accumulator charging switch." J. Taylor. January 13th.

1,960. "Telephone transmitters, microphones, &c." S. Hockly. January 13th.

1,985. "Step-by-step electrical motors." A. P. Addison and C. R. Payne. January 13th.

1,986. "Step-by-step electrical motors." A. P. Addison and J. F. B. Carslake. January 13th.

1,989. "Electric gas lamps with glow discharge." Studien. Ges. für Elektrische Leuchtröhren. January 13th. (Germany, June 16th, 1920.)

2,016. "Single deck tramcars." W. E. Hall. January 13th.

2,017. "Tramway vehicles." W. E. Hall. January 13th.

2,018. "Current regulator for automobile headlights." H. E. Wallace. January 13th.

2,032. "Means for electrically indicating vacant seats in theatres, &c." D. L. Robertson, R. Robertson, and R. C. Robertson. January 14th.

2,071. "Apparatus for recording calls made by telephone subscriber." E. Webb and H. J. Webb. January 14th.

2,080. "Devices for sparkless disconnection of inductive resistance." F. Krupp Akt.-Ges. January 14th. (Germany, February 12th, 1920.)

2,081. "Electrical switches." Electrical Improvements, Ltd., and R. W. Gregory. January 14th.

2,084. "Device for recording telephone calls." H. A. Levens. January 14th.

2,094. "Means for registering telephone calls." G. C. & G. C. N. Beall. January 14th.

2,096. "Apparatus for controlling and regulating electric currents." A. W. Sharman. January 14th.

2,098. "Means for recording telephone calls." Sir C. C. Allom, S. Fisher, and O. V. Sigurdsson. January 14th.

2,110. "High-frequency telegraphy and telephony over wires." Ges. für Drahtlose Telegraphie. January 14th. (Germany, January 16th, 1920.)

2,112/3/4. "Resistance switches for controlling intensity of electric currents." J. Watkinson. January 14th.

2,116. "Electric conductors." G. M. von Hassel. January 14th.

2,118. "Sparking plugs." P. Gueniffey. January 14th.

2,134. "Telemeters." J. H. L'A. Lund. January 15th. (Norway, January 16th, 1920.)

2,165. "Lighting gas fires by means of electricity." W. L. D. Gundry and Lord & Shand, Ltd. January 15th.

2,176. "Flywheel magneto and electric lighting generator." A. H. Dye and F. W. Lucas. January 15th.

2,204. "Holders for incandescent electric lamps." A. Armstrong. January 15th.

2,207. "Submarine sound transmitters." H. Simmacher. January 15th. (Germany, January 15th, 1920.)

2,245. "Suspension of train-lighting dynamos." British Lighting & Ignition Co., Ltd., and J. Etchells. January 17th.

2,269. "Carrying out electro-chemical gas reactions." Elektrosynthese Ges. January 17th. (Austria, July 19th, 1917.)

2,274. "Variable resistances." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 17th.

2,298. "Mercury vapour rectifiers combined with mechanical current interrupters." Akt.-Ges. Brown, Boveri et Cie. January 17th. (Switzerland, January 31st, 1920.)

2,299. "Insulators for electric lines." Soc. le Basalte. January 17th. (France, January 23rd, 1920.)

2,307. "Insulators for conductor rails, &c." W. H. Meyrick. January 17th.

2,337. "Time switches." E. J. Piper. January 17th.

2,365. "Electric junction boxes." F. Cox. January 18th.

2,379. "Balancing ocean cable systems." Western Union Telegraph Co. January 18th. (United States, January 28th, 1920).

2,385. "Electric cooking and heating devices." Falkirk Iron Co., Ltd., and A. R. Wood. January 18th.

2,392. "Subscribers' instruments for automatic telephone systems." C. R. Riber and Siemens Bros. & Co., Ltd. January 18th.

2,410. "Leading-in tube for electric wires." G. E. Gurney. January 18th.

2,415. "Elastic fluid turbines." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 18th.

2,416. "Casings for electrical apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 18th.

2,417. "Electric furnaces." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 18th.

2,432. "Bonding blocks for metal-covered electric wiring." R. C. Milliken. January 18th.

2,483/4. "Ignition systems for internal combustion engines, &c." R. Bosch Akt.-Ges. January 19th. (Germany, January 19th, 1920.)

2,489. "Terminals for electric conductors." E. J. Bastock. January 19th.

2,497. "Telephone systems." H. H. Harrison. January 19th.

2,499/2,502. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. January 19th.

2,502. "Telephone systems." R. Mercer and W. O. Passmore. January 19th.

2,504. "Signalling apparatus for mine shafts." R. Blunt and H. F. Mitchell. January 19th.

2,509. "Fuse boxes for electric cables." R. A. Macaulay. January 19th.

2,519. "Spring device for suspending electric lamps, &c." R. P. Maclarlane. January 19th.

2,546. "Sparking plug testing appliances." W. Howlett. January 19th.

2,551. "Electric arc welding of studs, tubes, &c., to metal plates, bodies, &c." A. E. McCarthy, H. Martin, and L. J. Steele. January 19th.

2,557. "Apparatus for suppressing earthing currents in high-voltage nets." Siemens-Schuckertwerke. January 19th. (Germany, January 27th, 1920.)

2,560. "Electron discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.), and General Electric Co. January 19th.

2,562. "Electric relays." F. Bergmann and Igranic Electric Co., Ltd. January 19th.

2,565. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. January 19th. (United States, January 19th, 1920.)

2,576. "Electro magnetic wave transmitting systems." O. C. Roos. January 19th.

2,579. "Electric welding of chain links, &c." Columbus McKinnon Chain Co. January 19th. (United States, July 7th, 1919.)

2,591. "Non-luminous electric heaters." G. Wheeler. January 19th.

2,653. "Make-and-break devices for induction coils, &c." M. A. Codd. January 20th.

2,670. "Pendulum electrical indicators." R. Scruby. January 20th.

2,671. "Elevators and/or conveyors." E. W. Woolgar. January 20th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

8,239. "Telephone system in which the lines are interconnected by the aid of electro-mechanically controlled switches." Aldendorff. April 1st, 1914. (Addition to 28,502, 1913.)

1917.

5,400. "Metals and their manufacture." British Thomson-Houston Co., Ltd. (General Electric Co.). April 17th, 1917. (155,851.)

1918.

6,515. "Application of thermionic valves to production of alternating currents and relaying." W. H. Eccles and F. W. Jordan. April 17th, 1918. (155,854.)

1919.

9,095. "Systems for supplying electric power for lighting purposes from low-frequency power circuits." Electrical Improvements, Ltd., and J. R. Beard. April 10th, 1919. (155,858.)

18,886. "Lighting system for power tables." W. Fairweather (Singer Manufacturing Co.). July 30th, 1919. (155,867.)

20,791. "Miners' electric safety lamps." Haslam & Stretton, Ltd., and J. W. Jones. April 22nd, 1920. (155,873.)

21,159. "Electric telegraph systems." Western Electric Co., Ltd. (Western Electric Co. (Inc.). August 28th, 1919. (155,877.)

22,184. "Air-cooling apparatus." K. Baumann and Metropolitan-Vickers Electrical Co., Ltd. September 9th, 1919. (155,881.)

23,292. "Electric welding machines." British Thomson-Houston Co., Ltd. (General Electric Co.). September 22nd, 1919. (155,889.)

23,349. "Sparking plugs for motor bicycles." R. T. Goodyear. September 23rd, 1919. (155,900.)

25,505. "Paste for electric storage battery plates." T. A. Willard. October 17th, 1919. (155,944.)

25,598. "Magneto-electric machines." M. M. Cardellino. October 18th, 1919. (155,946.)

26,154. "Radiating or cooling apparatus." K. Baumann and Metropolitan-Vickers Electrical Co., Ltd. October 24th, 1919. (155,950.)

26,352. "Turbo-electric driving arrangements." Brush Electrical Engineering Co., Ltd., and C. C. Sutton. October 27th, 1919. (155,954.)

26,495. "Electric light fittings." H. A. J. H. Murrey and F. W. Standish. October 28th, 1919. (155,955.)

26,837. "Conductor arrangements of electric traction systems." C. E. Fairburn. October 31st, 1919. (155,959.)

28,944. "Telegraph printing systems." Automatic Telephone Manufacturing Co., Ltd., H. H. Harrison, and S. R. Smith. November 21st, 1919. (155,975.)

1920.

4,979. "Distributing terminals for ignition magnetos." Fabriques des Montres Zenith. June 11th, 1919. (144,609.)

5,437. "Controlling device for electrically-heated utensils." Landers, Frary & Clark. May 29th, 1919. (144,254.)

8,170. "Interrupters for use with high-tension magnetos." J. Guardiola. January 16th, 1919. (140,459.)

10,062. "Alternating current motors." F. Punga. March 26th, 1919. (141,383.)

11,519. "Conversion of electric currents." Siemens-Schuckertwerke. Ges. February 7th, 1917. (142,465.)

15,210. "Telephone exchange systems." Western Electric Co., Ltd. August 23rd, 1919. (150,300.)

17,760. "Process of electrolytically separating copper from nickel." P. Goldberg. July 9th, 1918. (145,600.)

18,718. "Electric steel-yard weighing machine." K. Schember and R. Joksch. July 8th, 1919. (146,843.)

24,472. "Ejectors for withdrawing condensate from condensers." Metropolitan-Vickers Electrical Co., Ltd. September 30th, 1919. (151,976.)

24,854. "Electrolytic tanks with diaphragm cells." G. Haglund. September 17th, 1919. (151,260.)

25,438. "Repeaters for multiplex signalling systems." Western Electric Co., Ltd. September 26th, 1919. (151,600.)

25,792. "Process and apparatus for starting polyphase asynchronous electric motors." Akt.-Ges. Brown, Boveri et Cie. September 8th, 1919. (150,746.)